Supreme Court, U.S.
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No. ___

IN THE

Supreme Court of the United States

AKEVA L.L.C.,

Petitioner,

v.

ADIDAS AMERICA, INC.,

Respondent.

On Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

PETITIONER'S PATENT APPENDIX

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April 12, 2007

**Counsel of Record*

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Patent Appendix A

US006604300B2

(12) **United States Patent**
Meschan

(10) **Patent No.: US 6,604,300 B2**
(45) **Date of Patent: *Aug. 12, 2003**

(54) **ATHLETIC SHOE WITH IMPROVED SOLE**

(75) Inventor: **David F. Meschan**, Greensboro, NC (US)

(73) Assignee: Akeva L.L.C., Greensboro, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: 10/007,535

(22) Filed: Dec. 4, 2001

(65) **Prior Publication Data**

US 2002/0116842 A1 Aug. 29, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/641,148, filed on Aug. 17, 2000, now Pat. No. 6,324,772, which is a continuation of application No. 09/512,433, filed on Feb. 25, 2000, now Pat. No. 6,195,916, which is a continuation of application No. 09/313,667, filed on May 18, 1999, now Pat. No. 6,050,002, which is a continuation of application No. 08/723,857, filed on Sep. 30, 1996, now Pat. No. 5,918,384, which is a continuation-in-part of application No. 08/291,945, filed on Aug. 17, 1994, now Pat. No. 5,560,126, which is a continuation-in-part of application No. 08/108,065, filed on Aug. 17, 1993, now Pat. No. 5,615,497.

(51) **Int. Cl.**[7] **A43B 21/32**; A43B 13/48

(52) **U.S. Cl.** ..... **36/25 R**; 36/37; 36/28; 36/27; 36/35 R

(58) **Field of Search** ..... 36/37, 25 R, 15, 36/100, 105, 103, 42, 31, 35 R, 35 B, 27, 28

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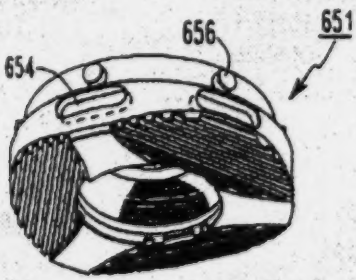
Primary Examiner—M. D. Patterson
(74) *Attorney, Agent, or Firm*—Martin & Ferraro, LLP

(57) **ABSTRACT**

A shoe has an upper, a foot support region positioned below at least a portion of the upper to support the bottom of a user's foot, a sole secured below the foot support region, and a flexible member positioned below at least a portion of the foot support region and above at least a portion of the sole. The flexible member has a top surface, a bottom surface, a peripheral portion, and an interior portion. The interior portion of the flexible member deflects in use in a direction substantially perpendicular to a major longitudinal axis of the shoe. At least a portion of the peripheral portion is restrained from movement relative to the interior portion in a direction substantially perpendicular to the major longitudinal axis of the shoe.

239 Claims, 27 Drawing Sheets



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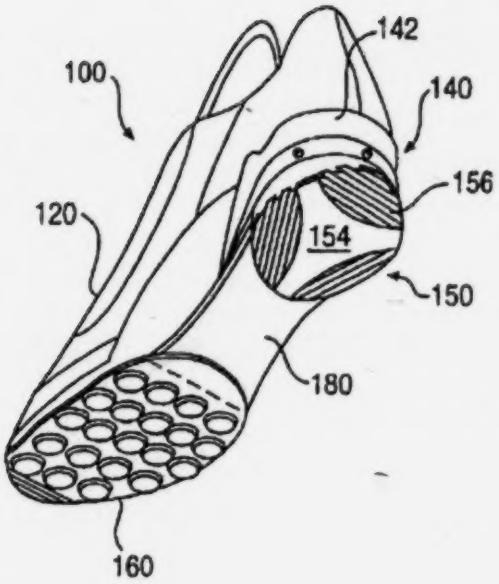

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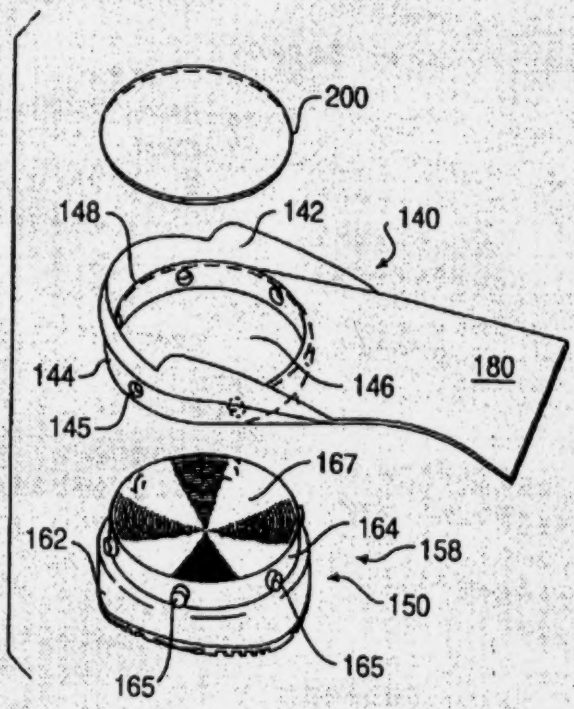

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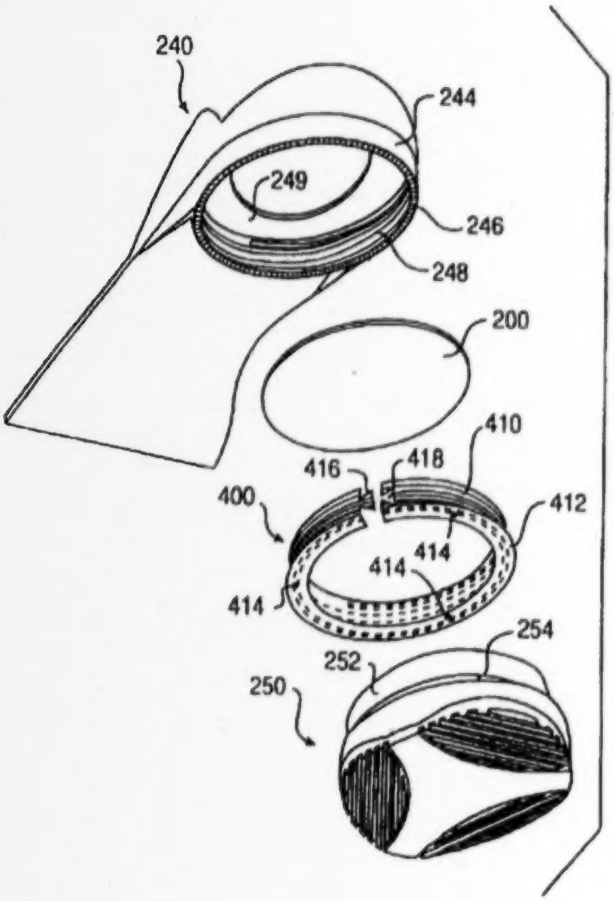
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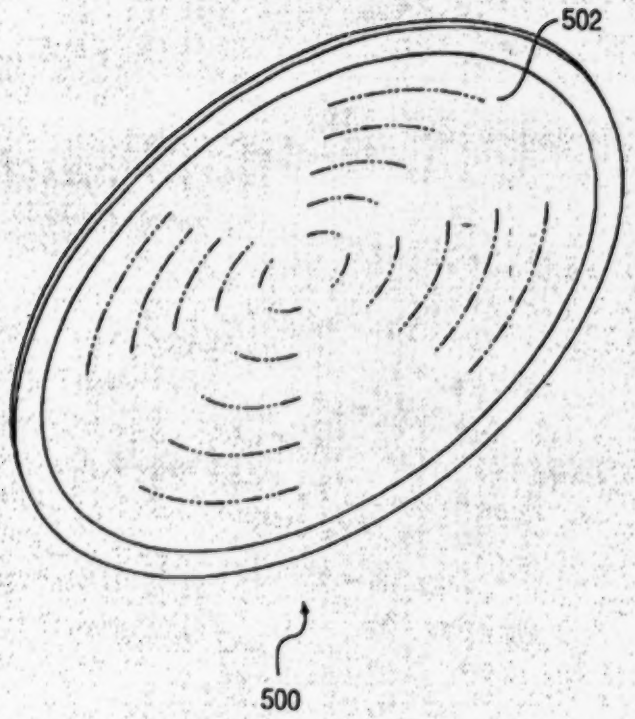

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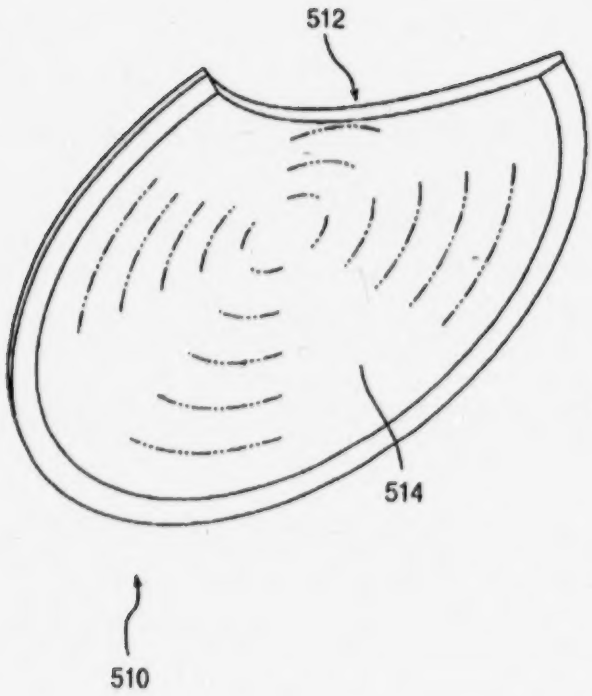

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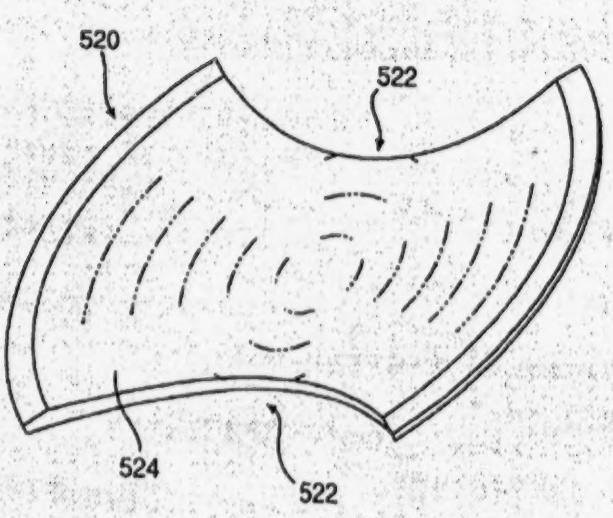

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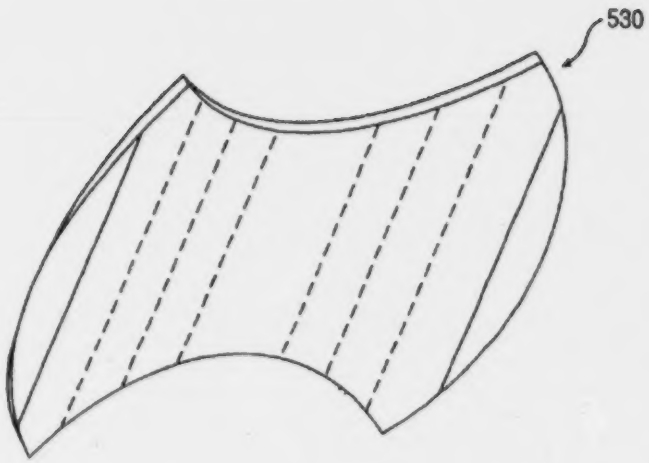

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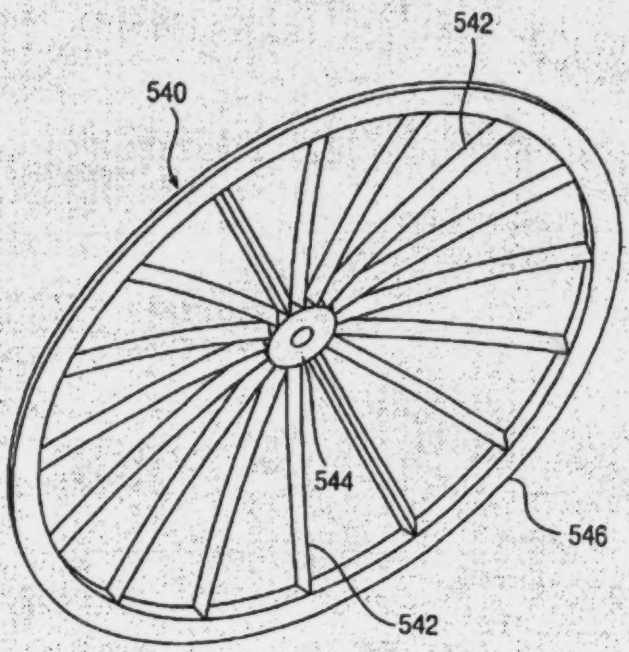

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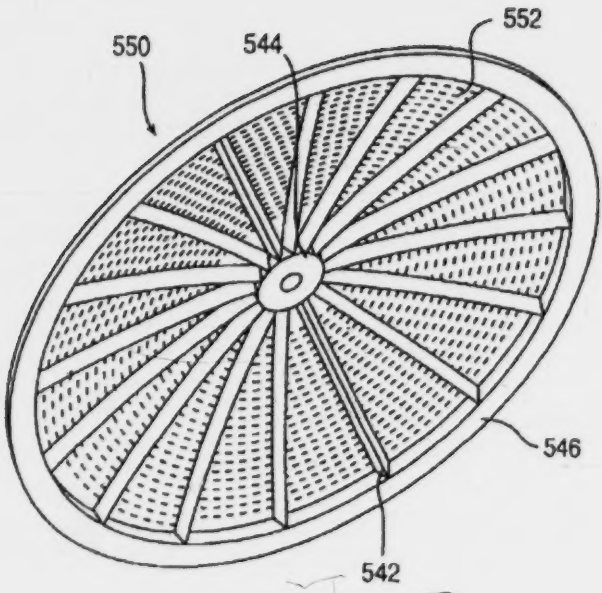

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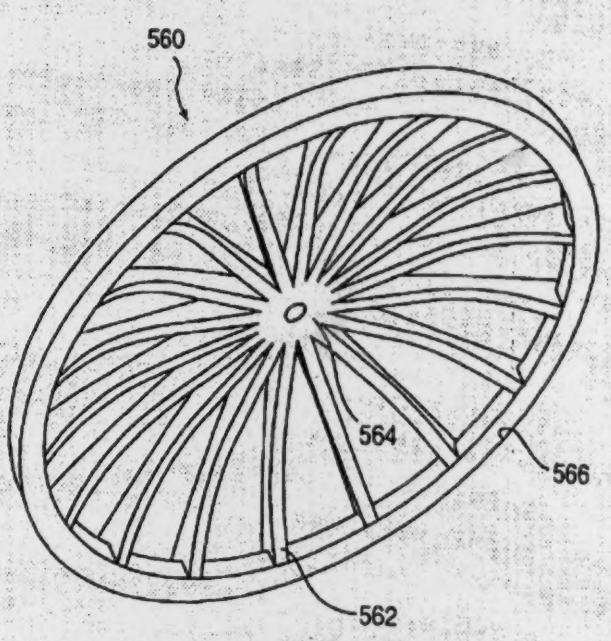

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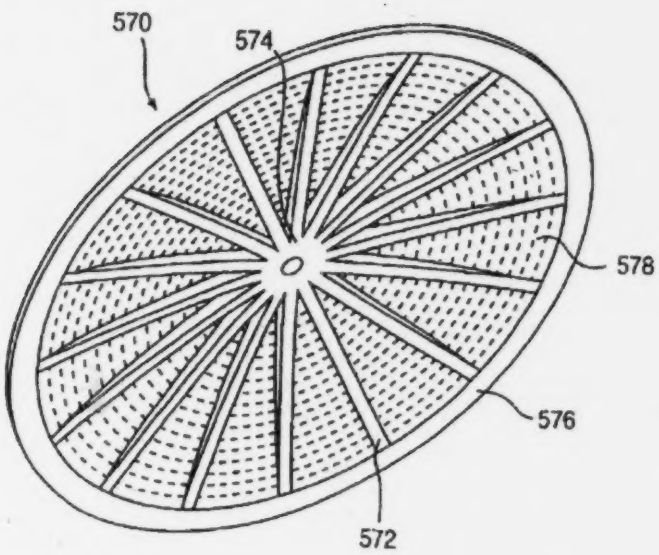

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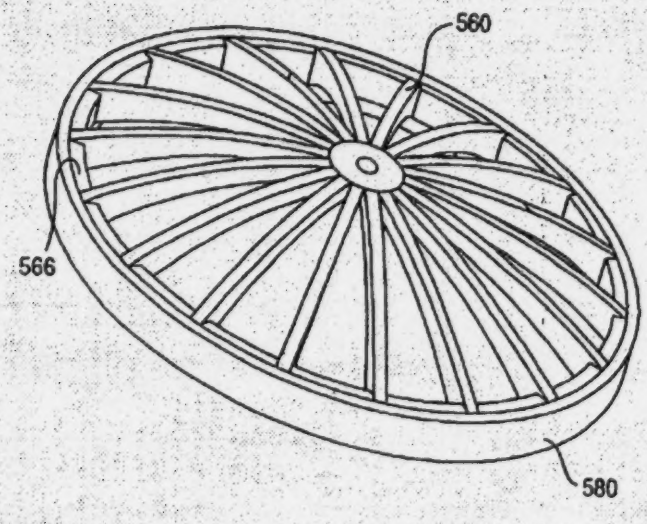

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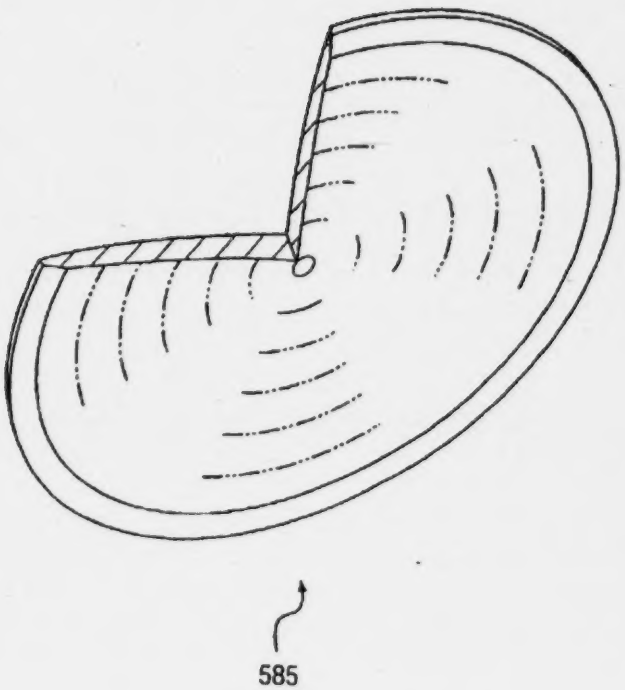

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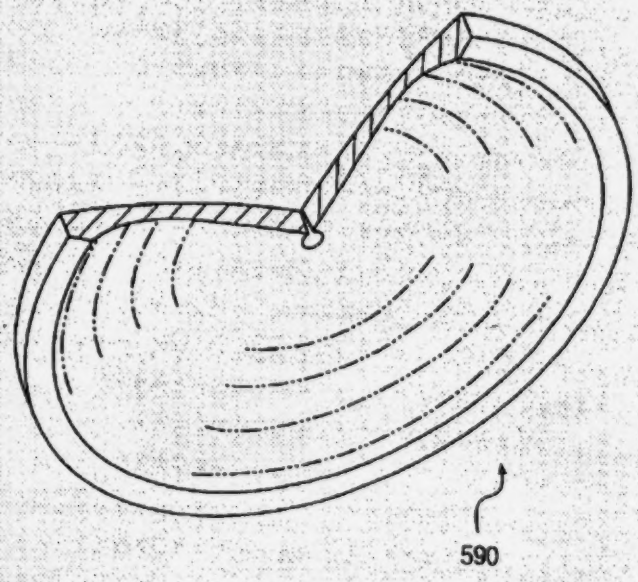

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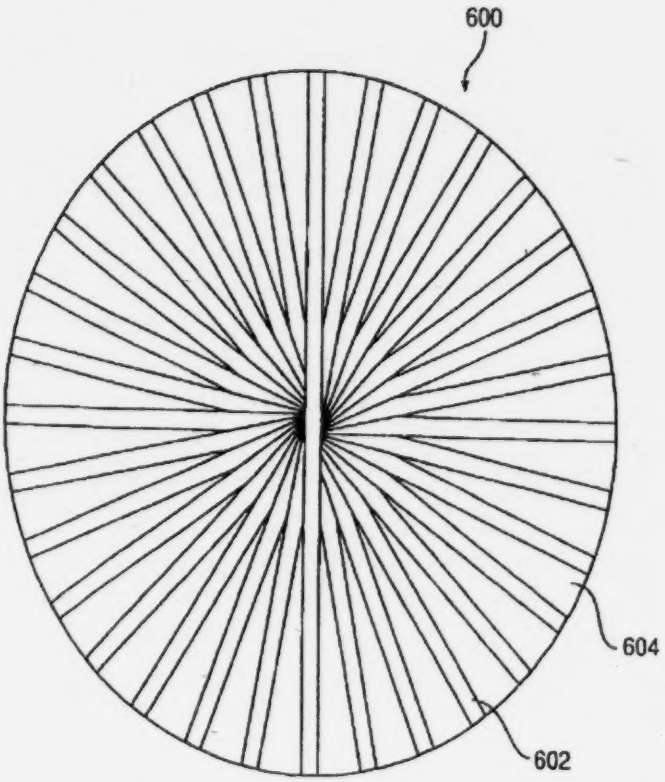

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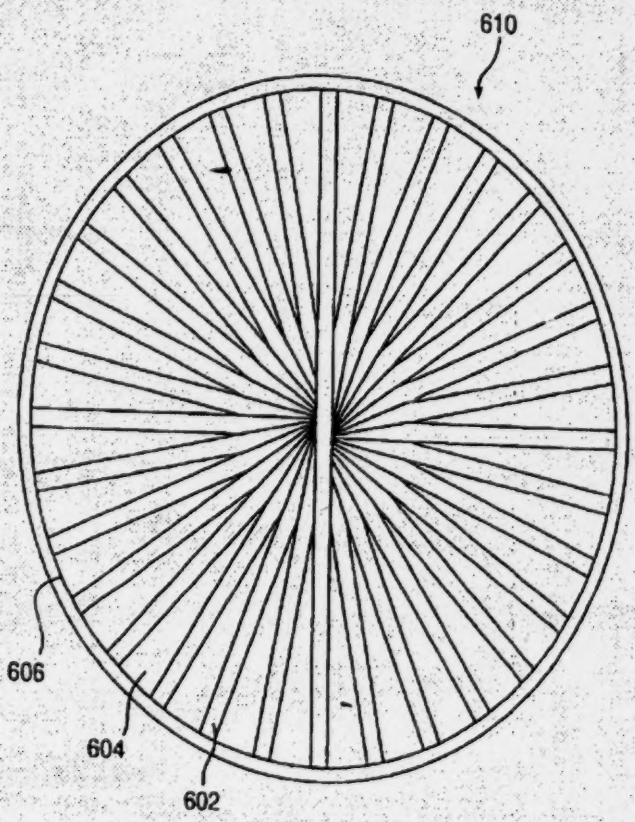

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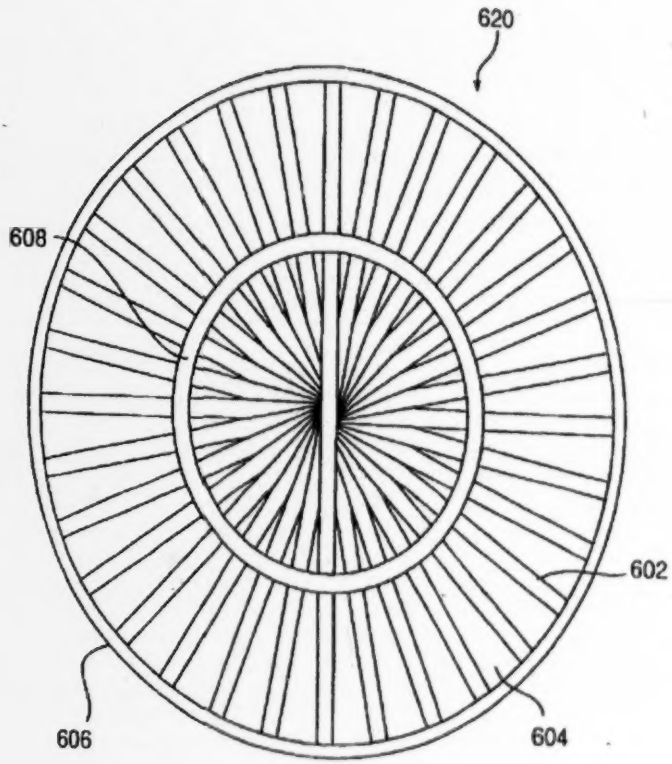

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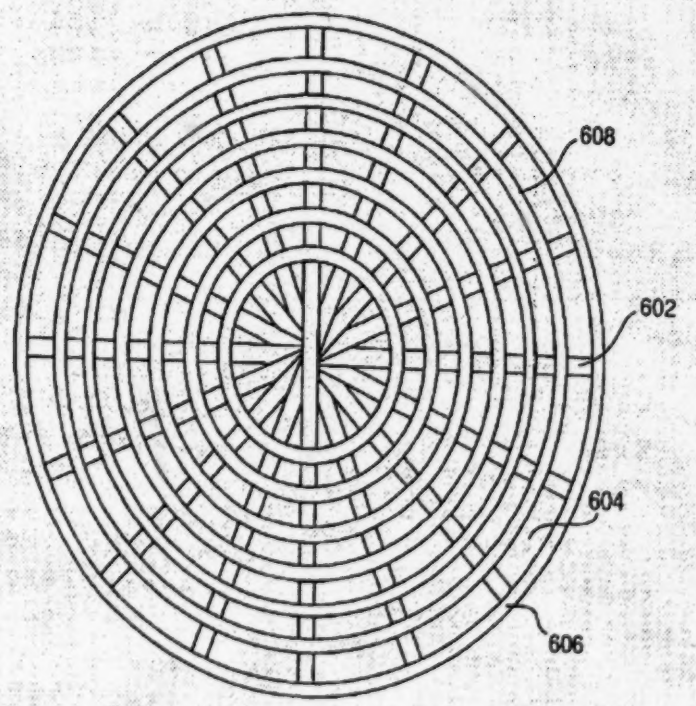

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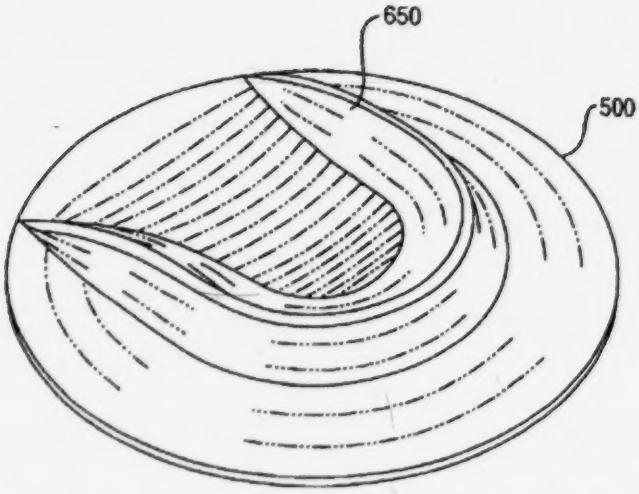

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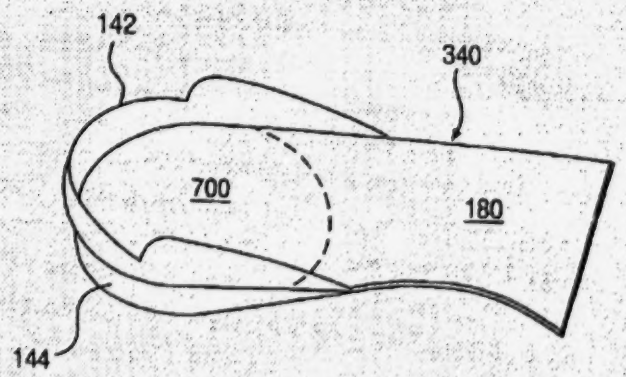

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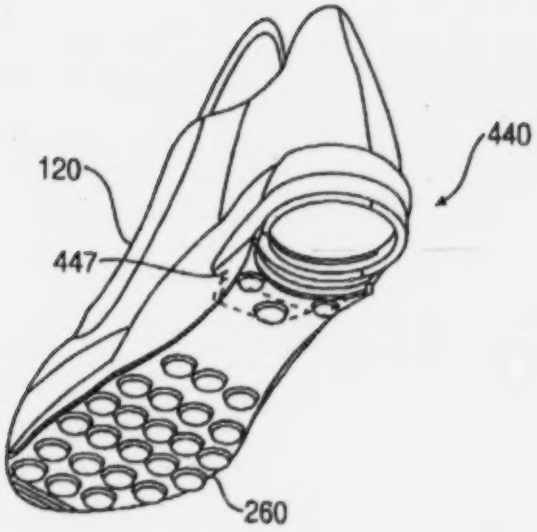

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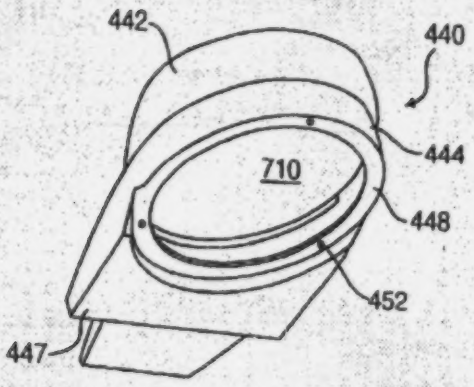

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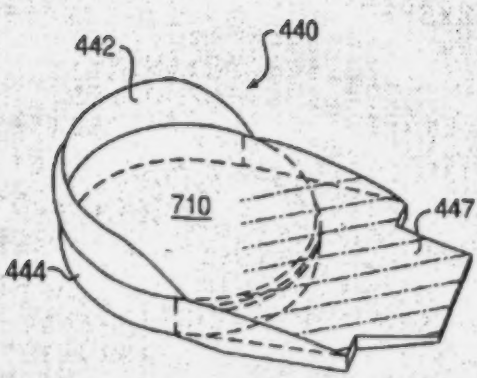

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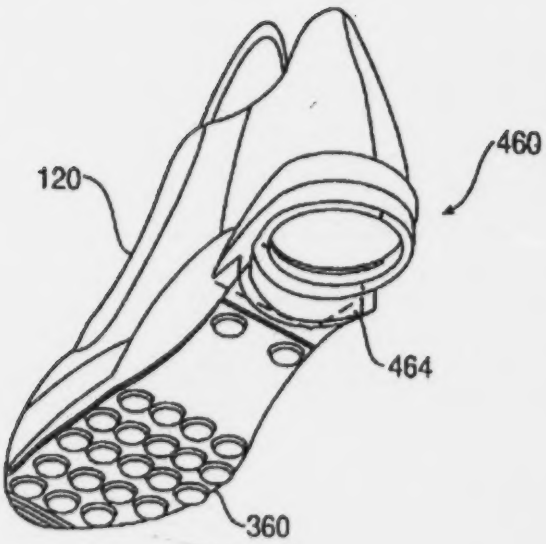

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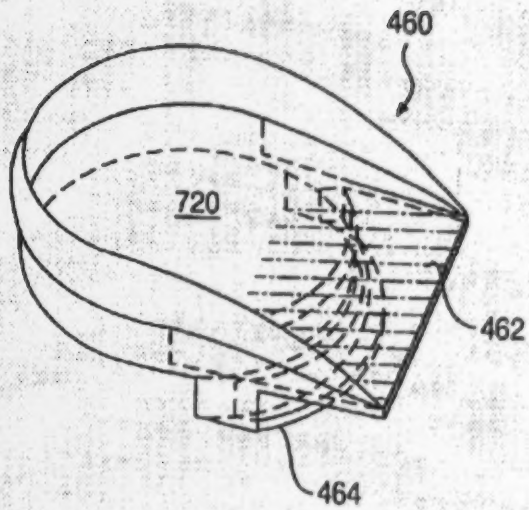

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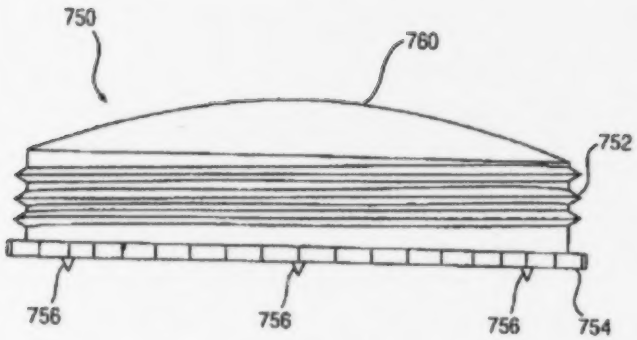

FIG. 25

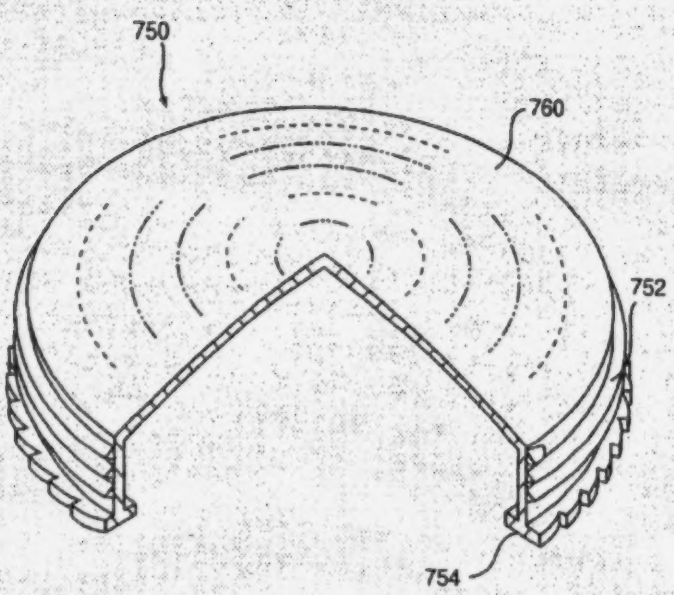

FIG. 26

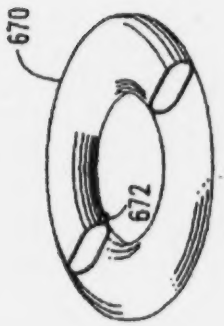

FIG. 28

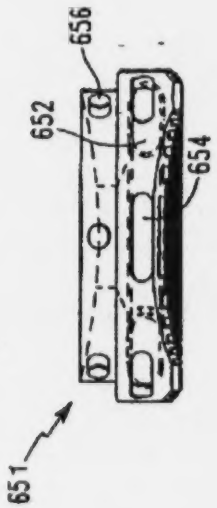

FIG. 29

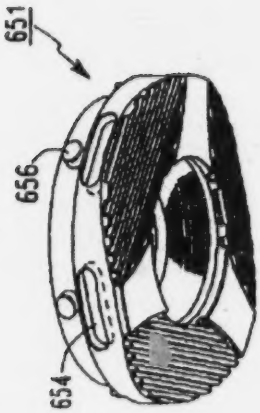

FIG. 27

ATHLETIC SHOE WITH IMPROVED SOLE

This is a continuation of application Ser. No. 09/641,148, filed Aug. 17, 2000, now U.S Pat. No. 6,324,772, which is a continuation of application Ser. No. 09/512,433, filed Feb. 25, 2000, now U.S. Pat. No. 6,195,916, which is a continuation of application Ser No. 09/313,667, filed May 18, 1999, now U.S. Pat. No. 6,050,002, which is a continuation of application Ser. No. 08/723,857, filed Sep. 30, 1996, now U.S. Pat. No. 5,918,384, which is a CIP of 08/291,945, filed Aug. 17, 1994, now U.S. Pat. No. 5,560,126, which is a CIP of 08/108,065, filed Aug. 17, 1993, now U.S. Pat. No. 5,615,497; all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an improved rear sole for footwear and, more particularly, to a rear sole for an athletic shoe with an extended and more versatile life and better performance in terms of cushioning and spring.

2. Discussion of the Related Art

Athletic shoes, such as those designed for running, tennis, basketball, cross-training, hiking, walking, and other forms of exercise, typically include a laminated sole attached to a soft and pliable upper. The laminated sole generally includes a resilient rubber outsole attached to a more resilient midsole usually made of polyurethane, ethylene vinyl acetate (EVA), or a rubber compound. When laminated, the sole is attached to the upper as a one-piece structure, with the rear sole being integral with the forward sole.

One of the principal problems associated with athletic shoes is outsole wear. A user rarely has a choice of running surfaces, and asphalt and other abrasive surfaces take a tremendous toll on the outsole. This problem is exacerbated by the fact that most pronounced outsole wear, on running shoes in particular, occurs principally in two places: the outer periphery of the heel and the ball of the foot, with peripheral heel wear being, by far, a more acute problem. In fact, the heel typically wears out much faster than the rest of a running shoe, thus requiring replacement of the entire shoe even though the bulk of the shoe is still in satisfactory condition.

Midsole compression, particularly in the case of athletic shoes, is another acute problem. As previously noted, the midsole is generally made of a resilient material to provide cushioning for the user. However, after repeated use, the midsole becomes compressed due to the large forces exerted on it, thereby causing it to lose its cushioning effect. Midsole compression is the worst in the heel area, including the area directly under the user's heel bone and the area directly above the peripheral outsole wear spot.

Despite technological advancements in recent years in midsole design and construction, the benefits of such advancements can still be largely negated, particularly in the heel area, by two months of regular use. The problems become costly for the user since athletic shoes are becoming more expensive each year, with some top-of-the-line models priced at over $150.00 a pair. By contrast, with dress shoes, whose heels can be replaced at nominal cost over and over again, the heel area (midsole and outsole) of conventional athletic shoes cannot be. To date, there is nothing in the art that successfully addresses the problem of midsole compression in athletic shoes, and this problem remains especially severe in the heel area of such shoes.

Another problem is that purchasers of conventional athletic shoes cannot customize the cushioning or spring in the heel of a shoe to their own body weight, personal preference, or need. They are "stuck" with whatever a manufacturer happens to provide in their shoe size.

Finally, there appear to be relatively few, if any, footwear options available to those persons suffering from foot or leg irregularities, foot or leg injuries, and legs of different lengths, among other things, where there is a need for the left and right rear soles to be of a different height and/or different cushioning or spring properties. Presently, such options appear to include only custom-made shoes that are prohibitively expensive and rendered useless if the person's condition improves or deteriorates.

SUMMARY OF THE INVENTION

The present invention is directed to a shoe that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the shoes and shoe systems particularly pointed out in the written description and claims, as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the shoe includes an upper having a heel region, a rear sole secured below the heel region of the upper, and a rear sole support attached to the upper and configured to secure the rear sole below the heel region of the upper. The rear sole support includes a flexible region positioned below the heel region of the upper and above a portion of the rear sole. The flexible region is sufficiently stiff to support a user while still being sufficiently flexible to flex and spring when the user runs or walks vigorously. The flexible region has an interior portion which in its normal, unflexed state is spaced upwardly from the portion of thy rear sole immediately below said interior portion, the interior portion being adapted to flex in a direction substantially perpendicular to the major longitudinal axis of the shoe as it is used.

The interior portion of the flexible region preferably is elevated relative to its peripheral portion in a direction toward the heel region of the upper. In certain embodiments the flexible region is an integral part of the rear sole support. The rear sole support may include an integral arch extension extending below the upper from a position proximate the heel region of the upper through a substantial portion of the arch region of the upper to support the arch region.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of an embodiment of the shoe of the present invention.

FIG. 2 is an exploded isometric view of a rear sole support, flexible member, and rear sole for the shoe of FIG. 1.

FIG. **3** is an exploded isometric view of another embodiment of a rear sole support, flexible member, and rear sole for use in the shoe of the present invention.

FIGS. **4-18** are isometric views of exemplary flexible member embodiments for use in the shoe of the present invention.

FIG. **19** is an isometric view of another embodiment of a rear sole support for use in the shoe of the present invention.

FIG. **20** is an isometric view of another embodiment of the shoe of the present invention.

FIGS. **21** and **22** are isometric views of a rear sole support for the shoe of FIG. **20**.

FIG. **23** is an isometric view of another embodiment of the shoe of the present invention.

FIG. **24** is an isometric view of a rear sole support for the shoe of FIG. **23**.

FIG. **25** is a side elevation view of a securing member for use in the shoe of the present invention.

FIG. **26** is a partial cut-away isometric view of the securing member of FIG. **25**.

FIGS. **27-29** are views of a rear sole for use in the shoe of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference characters will be used throughout the drawings to refer to the same or like parts.

FIG. **1** illustrates a first embodiment of the shoe of the present invention. The shoe, designated generally as **100**, has a shoe upper **120**, rear sole support **140**, a rear sole **150**, and a forward sole **160**. Shoe **100** also preferably includes a flexible member **200** (FIG. 2) positioned between rear sole **150** and a heel region of upper **120**. The flexible member provides spring to the user's gait cycle upon heel strike and reduces or eliminates interior rear midsole compression in that it is more durable than conventional midsole material.

Upper **120** may be composed of a soft, pliable material that covers the top and sides of the user's foot during use. Leather, nylon, and other synthetics are examples of the various types of materials known in the art for shoe uppers. The particular construction of the upper is not critical to the shoe of the present invention. It may even be constructed as a sandal or may be made of molded plastic, integral with the rear sole support, as in the case of ski boots or roller blade uppers.

Forward sole **160** is attached to upper **120** in a conventional manner, typically by injection molding, stitching, or gluing. Forward sole **160** typically includes two layers: an elastomeric midsole laminated to an abrasion-resistant outsole. The particular construction of the forward sole is not critical to the invention and various configurations may be used. For example, the midsole may be composed of material such as polyurethane or ethylene vinyl acetate (EVA) and may include air bladders or gel-filled tubes encased therein, and the outsole may be composed of, by means of example only, an abrasion-resistant rubber compound.

Rear sole support **140** is also attached to the heel region of upper **120** in a conventional manner, such as injection molding, stitching, or gluing. Rear sole support **140** is substantially rigid and is configured to stabilize the heel region of upper **120** and secure rear sole **150** below the heel

region. As shown in FIG. **2**, rear sole support **140** may include an upwardly extending wall **142**, referred to as a heel counter, that surrounds the periphery of the heel region of upper **120** to provide lateral stabilization. Wall **142** preferably surrounds the rear and sides of upper **120** proximate the heel region and in service supports and stabilizes the user's heel as he or she runs. Rear sole support **140** also includes a downwardly extending side wall **144** that defines a recess **146** sized to receive a portion of rear sole **150**, preferably a rear sole which is removable and rotatable to several predetermined positions. Wall **144** shown in FIG. **2** is generally circular and securely contains and holds rear sole **150**. A plurality of openings **145** is formed in wall **144** to facilitate securement of rear sole **150** to rear sole support **140**. The components of rear sole support **140** are preferably made integral through injection molding or other conventional techniques and are preferably composed of plastic, such as a durable plastic manufactured under the name PEBAX. It is further contemplated that the rear sole support can be made from a variety of materials, including without limitation other injection-molded thermoplastic engineering resins.

As shown in FIGS. **1** and **2**, rear sole support **140** may include an arch extension or support **180** to provide a firm support for the arch of the foot and to alleviate potential gapping problems where sole support wall **144** would be adjacent forward sole **160**. Arch extension **180** generally extends below upper **120** from the forward portion of side wall **144**, through the arch region. It may extend as far as the ball of the foot. It is attached to upper **120** and forward sole **160** by gluing or other conventional methods. Arch extension **180** may be composed of the same material as the rear sole support and made integral with rear sole support **140** by injection molding. Alternatively, it may be made of the same or a different stiff but flexible material (such as carbon or fiberglass ribbons in a resin binder) and glued to rear sole support **140**. Such one-piece construction of the arch extension together with the rear sole support solves another major problem, namely the tendency of an athletic shoe of conventional resilient material in the arch area to curl at the juncture of the substantially rigid rear sole support with the resilient forward sole.

Shoe **100** also includes a rear sole **150** that is detachably secured to and/or rotatably positionable relative to rear sole support **140**. Rear sole **150**, as shown in FIG. **1**, includes a rubber ground-engaging outsole **154** containing a planar area and three beveled segments or portions that soften heel strike during use. As shown, the beveled segments or portions formed on the outsole have the same shape and configuration and are positioned symmetrically about the periphery of the outsole and preferably symmetrically positioned about the center of rear sole **150**. As explained in more detail, rear sole **150** and the attachment features that permit rear sole **150** to be placed and locked into different positions relative to rear sole support **140** are designed and configured so that one symmetrically located beveled portion can be moved into the position previously occupied by another beveled portion. As a result, as one of the beveled portions begins to wear, rear sole **150** can be repositioned to place an unworn beveled portion in the area of the shoe where there is greater wear for a particular user. By periodically altering the position of the sole before any beveled portion is badly worn, (or any midsole material directly above the bevel is badly compressed) the life and effectiveness of the rear sole, and the entire shoe, can be significantly increased. Moreover, after a given rear sole wears beyond its point of usefulness, it can be replaced with a new sole with

the same or different characteristics. Prior to replacement, it is also possible that left and right rear soles may be exchanged with each other inasmuch as left and right rear soles often exhibit opposite wear patterns.

As shown in FIG. 2, rear sole **150** also includes a midsole **158** laminated to outsole **154**. Midsole **158** includes a substantially cylindrical lower portion **162** and a substantially cylindrical upper portion **164** that is smaller in diameter than lower portion **162**. Upper portion **164** includes a plurality of resilient knobs **165** that mate with openings **145** in rear sole support **140**. As shown, the resilient knobs **165** and openings **145** are symmetrically positioned about the central axis of midsole **158** and the recess of rear sole support **140**, respectively. To secure rear sole **150** to rear sole support **140**, rear sole **150** is simply press-fitted into recess **146** until knobs **165** engage corresponding openings **145**. This manner of locking rear sole **150** into the shoe at any one of several positions is one of several mechanical ways in which the rear sole can be removed, repositioned, and/or locked to the rear sole support or other part of a shoe.

In the embodiment shown in FIG. 2, upper midsole portion **164** has a diameter at least equal to and preferably slightly larger than that of the recess into which it fits. Midsole portion **162** has a diameter substantially equal to the diameter defined by the exterior portion of circular wall **144**. This configuration of elements eliminates any vertical gapping problems from occurring between the wall of the rear sole support and the peripheral surface of the rear sole.

The inside diameter of a circular recess **146**, as measured between the inside surfaces of its sidewalls, or the distance between the inside surface of a medial sidewall and the inside surface of an opposite lateral sidewall in the case of a non-circular recess (not shown), may actually be greater than the width of the heel region of the shoe upper as measured from the exterior surface of the medial side of the heel region of the upper to the exterior surface of the lateral side of the heel region of the upper (i.e., the heel region of the upper at its widest point). This is possible because the material used to make the rear sole support **140** and side walls is sufficiently strong and durable to permit the side walls to "flare out" to a greater width than the heel region of the upper without risk of breakage. This in turn permits the use of a larger rear sole **150** with more ground-engaging surface and, hence, more stability. (As stated, the exterior walls of the lower portion of the rear sole generally align vertically with the exterior surface of the side walls forming the recess **146**). It also permits the employment of a flexible region or member with a correspondingly larger diameter, width or length because its peripheral edges optimally should align vertically with the load-bearing side walls of the recess. Such a larger flexible region or member, with a diameter, width or length greater than the width of the heel region of the upper at its widest point, creates more cushioning and/or spring for the user's heel during the gait cycle. The observations and provisions contained in this paragraph are equally applicable to the embodiments described in FIGS. 1, 2, and 3.

Rear sole **150** is preferably made from two different materials: an abrasion-resistant rubber compound for ground-engaging outsole **154**; and a softer, more elastomeric material such as polyurethane or ethylene vinyl acetate (EVA) for midsole **158**. However, rear sole **150** could be comprised of a single homogenous material, or two materials (e.g., EVA enveloped by hard rubber), as well as a material comprising air encapsulating tubes, for example, as disclosed in U.S. Pat. No. 5,005,300. For each of the discussed rear sole embodiments, the outsole and midsole materials are preferably more resilient than materials used for the rear sole support or arch extension.

Detachability of rear sole **150** allows the user to change rear soles entirely when either the sole is worn to a significant degree or the user desires a different sole for desired performance characteristics for specific athletic endeavors or playing surfaces. The user can rotate the rear sole to relocate a worn section to a less critical area of the sole, and eventually replace the rear sole altogether when the sole is excessively worn. By periodically changing the position of the rear sole, more uniform wear and long life (both outsole and midsole) can be achieved. Additional longevity in wear may also be achieved by interchanging removable rear soles as between the right and left shoes, which typically exhibit opposite wear patterns.

In addition, some users will prefer to change the rear soles not because of adverse wear patterns, but because of a desire for different performance characteristics or playing surfaces. For example, it is contemplated that a person using this invention in a shoe marketed as a "cross-trainer" may desire one type of rear sole for one sport, such as basketball, and another type of rear sole for another, such as running. A basketball player might require a harder and firmer rear sole for stability where quick, lateral movement is essential, whereas a runner or jogger might tend to favor increased shock absorption features achievable from a softer, more cushioned heel. Similarly, a jogger planning a run outside on rough asphalt or cement might prefer a more resilient rear sole than the type that would be suitable to run on an already resilient indoor wooden track. Rear sole performance may also depend on the weight of the user or the amount or type of cushioning desired.

The present invention includes a shoe or shoe kit which includes or can accept a plurality of rear soles **150** having different characteristics and/or surface configurations, thereby providing a cross trainer shoe. As explained in more detail below, the shoe can also be designed to accept and use different flexible members in the rear sole area, to achieve optimal flex and cushioning, through the combination of a flexible member and rear sole selected to provide the most desirable flex, cushion, wear, support, and traction for a given application. In a preferred embodiment, both the rear sole and the flexible member are replaceable and a given rear sole can be locked in a plurality of separate positions relative to the recess in which it is held.

Since rear sole **150** shown in FIGS. 1 and 2 is selectively positionable relative to rear sole support **140** in a single plane about an axis perpendicular to the major longitudinal axis of the shoe, it may be moved to a plurality of positions with a means provided to allow the user to secure the rear sole at each desired position. After a period of use, outsole **154** will exhibit a wear pattern at the point in which the heel first contacts the ground, when the user is running, for example. Excessive wear normally occurs at this point, and at midsole **158** generally above this point, degrading the performance of the rear sole. When the user determines that the wear in this area is significant, the user can rotate the rear sole so that the worn portion will no longer be in the location of the user's first heel strike. For the shoe shown in FIGS. 1 and 2, rotation is accomplished by detaching the rear sole and reattaching at the desired location. For the embodiment in FIG. 3 discussed below, the rear sole may be rotated without separating it from the rear sole support. The number of positions into which rear sole of FIGS. 1 and 2 can be rotated is limited by the number of knobs/openings, but is unlimited for the rear sole shown in FIG. 3. The use of other mechanical locking systems to allow selective movement

and locking of the rear sole is contemplated within the spirit of the invention.

Rotating the rear sole about an axis normal to the shoe's major axis to a position, for example, 180 degrees beyond its starting point, will locate the worn portion of the rear sole at or near the instep portion of the shoe. The instep portion is an area of less importance for tractioning, stability, cushioning and shock absorbing purposes. As long as the worn portion of the rear sole is rotated beyond the area of the initial heel strike, prolonged use of the rear sole is possible. The user can continue periodically to rotate the rear sole so that an unworn portion of the rear sole is located in the area of the first heel strike.

The shape of rear sole can be circular, polygonal, elliptical, "sand-dollar," elongated "sand-dollar," or otherwise. The shape of recess **146** is formed to be compatible with the shape of the rear sole. In all embodiments, the invention includes mechanical means for selectively locking the rear sole relative to the rear sole support and upper of the shoe. Preferably, the rear sole is shaped so that at least the rear edge of the outsole has a substantially identical profile at several, or preferably each rotated position. To allow for a plurality of rotatable positions, the shape of the outsole preferably should be symmetrical about its central axis. As shown in FIG. **1**, the rear sole has four beveled portions which are symmetrically positioned about its central axis. The user in this embodiment can rotate the rear sole 120° and place an unworn beveled portion at the rear heel region of the shoe, where wear is often maximum. Alternatively, the rear sole could have two beveled portions, 180° apart (in an oval embodiment this would have to be the case), in which event only one rotation per shoe, plus an exchange between right and left rear soles, would be possible, before replacement of rear soles would be necessary.

While the above discussion is directed towards a rear sole that rotates or separates in its entirety, it is specifically contemplated that the same benefits of this invention can be achieved if only a portion of the rear sole is rotatable or removable. For example, a portion of the rear sole, e.g., the center area, may remain stationary while the periphery of the ground-engaging surface or outsole rotates and/or is detachable. As another example, the rear sole may not be removable but only rotatably positionable.

In a preferred embodiment of the invention, the shoe of the present invention includes a flexible region **200** that is positioned above the rear sole and has a central portion that in its normal unflexed state is spaced upwardly from the portion of the shoe (rear sole support, or rear sole) immediately below it. The flexible region **200** is designed to provide a preselected degree of flex, cushioning, and spring, to thereby reduce or eliminate heel-center midsole compression found in conventional materials. Flexible region **200** is made of stiff, but flexible, material. Examples of materials that may be used in the manufacture of flexible member **200** include the following: graphite; fiberglass; graphite (carbon) fibers set in a resin (i.e. acrylic resin) binder, fiberglass fibers set in a resin (i.e. acrylic resin) binder, a combination of graphite (carbon) fibers and fiberglass fibers set in a resin (i.e. acrylic resin) binder, nylon, glass-filled nylon, epoxy, polypropylene, polyethylene, acrylonitrile butadiene styrene (ABS); other types of injection-molded thermoplastic engineering resins, spring steel; and stainless spring steel. The flexible region **200** can be incorporated into other elements of the shoe or can be a separate flexible member or plate.

As shown in FIG. **2**, flexible member **200** can be in the form of a plate supported at its peripheral region by an upward facing top surface of rear sole support **140**. In this embodiment, the member, or plate **200** is positioned between the rear sole **150** and the heel portion of upper **120**. A ledge **148** may be formed in rear sole support **140** to support and laterally stabilize flexible member **200**.

The flexible member may also be permanently attached to the top or bottom of the rear sole support or detachably secured to the shoe upper and removable through a pocket formed in the material (not shown) typically located on the bottom surface of the upper, or it can be exposed and removed after removing the sock liner or after lifting the rear portion of the sock liner. Alternatively, it may be totally exposed as in the case of flexible member **200** shown in FIG. **18**, wherein the U-shaped cushioning member may have direct contact with the user's heel without an intervening sock liner in the heel portion of the shoe. The removability of the flexible member allows the use of several different types of flexible members of varying stiffness or composition and, therefore, can be adapted according to the weight of the runner, the ability of the runner, the type of exercise involved, or the amount of cushioning and/or spring desired in the heel of the shoe.

Rear sole **150** may have a concave top surface **167**, as shown in FIG. **2**. Therefore, when the rear sole is attached to the rear sole support, the top surface of the rear sole does not come into contact with the flexible member when the flexible member deflects within its designed range of flex. As a result, the middle of the flexible member can flex under the weight of the user without being impeded by rear sole **150**. Flexible member **200** thus acts like a trampoline to provide extra spring in the user's gait in addition to minimizing, or preventing, midsole compression in the central portion of the rear sole.

A second preferred embodiment is shown in FIG. **3**. In this embodiment, a rear sole **250** is identical to rear sole **150** shown in FIG. **2** except that it has a groove **254** below upper midsole portion **252**, instead of knobs **165**. A rear sole support **240** includes a downwardly extending wall **244** that has a serrated bottom edge **246** and a threaded inner surface **248**. Rear sole support **240** also includes an upper rim **249**.

The embodiment of FIG. **3** also indicates a threaded ring **400**. Ring **400** includes a threaded outer rim **410** that mates with threaded inner surface **248** of rear sole support **240**. The ring also includes an outwardly and inwardly extending flange **412** that presses against serrated bottom edge **246** when the ring is screwed into the rear sole support. The bottom surface of flange **412** includes anchors **414**, and may also be serrated to further grip the rear sole to prevent rotation. The ring also has two ends **416** and **418**, and end **416** may have a male member and end **418** may be shaped to receive the male member to lock the two ends together. Ring **400** may be made of hard plastic or other substantially rigid materials that provide a secure engagement with rear sole support **240** and a firm foundation for supporting flexible member **200**.

Rear sole **250** is attached to rear sole support **240** by unlocking the ends of ring **400** and positioning ring **400** around upper midsole portion **252** of the rear sole such that flange **412** engages groove **254**. Ring **400** is then firmly locked onto the rear sole by mating end **416** with end **418**. Flexible member **200** is inserted into the rear sole support so that it presses against upper rim **249**. Ring **400**, with rear sole **250** attached, is then screwed into the rear sole support by engaging threaded surface **410** of the ring with threaded surface **248** of wall **244**. The ring is then screwed into the rear sole support until serrated edge **246** of wall **244** engages

flange 412 of ring 400. Serrated edge 246 serves to prevent rotation of the ring during use and the top edge of ring 400 firmly supports flexible member 200.

The rear sole support sidewalls need not be continuous around the entire recess. Such sidewalls may be substantially eliminated on the lateral and medial sides of the rear sole support, or even at the rear and/or front of the rear sole support, exposing ring 400 when installed, even allowing it to protrude through the sidewalls where the openings are created This has no effect whatsoever on the thread alignment on the inside surface of the remaining sidewalls. The advantage of doing this is that a ring with a slightly larger diameter than otherwise possible and, hence, a flexible member with a slightly larger diameter than otherwise possible may be employed.

In the embodiment shown in FIG. 3, a variety of different flexible members 200 having different flex and cushioning characteristics can be selectively incorporated into the shoe. Flexible member 200, once incorporated into the shoe, is securely held in place with rear sole support 240. Preferably, the rear sole support contacts flexible member 200 only along its outer periphery, and rear sole support 240 includes an opening above the flexible member, thereby permitting the plate to protrude upwardly toward the user's heel. Moreover, because the top surface of rear sole 250 is preferably concave in shape, the central portion of the rear sole does not contact the central portion of the flexible member in its unflexed, normal position. As a result, the flexible member can also flex downward. The degree of flexing of the member can be controlled both by the selection of the material and shape of the member, as well as the relative dimensions and shape of rear sole support 240 and rear sole 250. While flexible member 200 and the corresponding recess in rear sole support 240 are circular in FIG. 3, other shapes can be utilized. Rear sole support 240 could be designed to include a recess above upper rim 249 to accept the flexible member and a mechanical means, such as a circular locking ring, similar to ring 400, to support and lock the flexible member in place. In such an embodiment, the user could change the flexible member from the inside of the shoe. Similarly, the flexible member 200 could be fixedly secured to, or incorporated as an integral part, of either the rear sole support or the rear sole. Similar configurations of an integral flexible region are within the spirit of the invention.

The embodiment of FIG. 3 and other embodiments of the invention preferably provide a shoe that includes a flexible region or member which has its own preselected spring and cushioning characteristic and which is preferably removable and replaceable, a rear sole with its own pre-selected cushioning properties (both outsole and midsole) and which is preferably removable, replaceable, and capable of being locked in place at a plurality of preselected positions; a plurality of beveled portions on the outer surface of the rear sole which are preferably symmetrically located about its axis; and an interrelationship of the flexible member, rear sole support, and rear sole which permit the flexible member to freely flex to at least a predetermined degree. The flexible region and its characteristics, the rear sole and its characteristics, and the rear sole's relative location to the flexible region can be selectively altered, to provide in combination an optimal shoe for a given application. Also, because of the rear sole rotation and replacement permitted by the invention, typically heavy outsole material may be made thinner than on conventional athletic shoes, thus reducing the weight of the shoe. The invention also permits the weight of the shoe to be further reduced because the central portion of the midsole of the rear sole can be eliminated, since the flexible region of the shoe provides weight bearing and cushioning at this area

Other rear sole support/rear sole combinations for securing the rear sole to the shoe and for supporting the flexible member at or below the heel region of the upper are contemplated and fall within the spirit of this invention, as described and claimed. By means of example only, some such additional configurations are disclosed in commonly-owned U.S. patent application Ser. No. 08/291,945, which is incorporated herein by reference.

The flexible region of the present invention is not limited to a circular shape and can be adapted to conform to the shape of the rear sole. The flexible region also need not be used only in conjunction with a detachable rear sole, but can be used with permanently attached rear soles as well.

FIGS. 4–17 show various alternative embodiments of the flexible member. In each of these embodiments, the flexible member may be curved or convex in shape, or have an inwardly curved or concave bottom surface, such that the interior portion of the flexible member is elevated relative to its periphery when the flexible member is positioned in the shoe in its normal position. Each of the following flexible member embodiments may be used in conjunction with the rear sole support/rear sole combinations disclosed in FIGS. 1–3 and more generally disclosed in this disclosure in its entirety. In addition the following disclosed embodiments of flexible members can be integrally incorporated into a portion of the shoe. In either event, the resultant shoe has a flexible region which provides a preselected flex and spring.

As shown in FIG. 4, flexible member 500 has a concave under surface 502 (when viewed from its bottom) and an opposing convex upper surface, and is circular in shape. As a result, the interior portion of the flexible member 500 is elevated relative to its peripheral portion and is positioned below the rear sole of the user when supported in the shoe.

Flexible members 510 and 520 shown in FIGS. 1 and 6, respectively, are similar in structure to flexible member 500 except that flexible member 510 has a bottom surface 514 and a moon-shaped notch 512 and flexible member 520 has a bottom surface 524 and two opposing moon-shaped notches 522. Notch 512 of flexible member 510 is preferably aligned with the back of the rear sole. One of notches 522 of flexible member 520 may be aligned with the back of the rear sole, or alternatively such notches may be aligned with the lateral and medial sides of the shoe. Flexible member 530 as shown in FIG. 7 is identical in structure to flexible member 520 shown in FIG. 6 except that it is not convex in shape, but rather curved in only one direction. The flexible member 530 alignment options are the same as those of flexible member 520.

As shown in FIG. 8, flexible member 540 includes a plurality of spokes 542 each joined at one end to a hub 544 and joined at an opposite end to rim 546. The size, shape, and number of spokes is variable depending on the desired flexibility. As shown in FIG. 8, each of spokes 542 has a triangular cross-section, although the cross-section may also be square, rectangular, or any other geometrical shape. When positioned in the shoe, hub 544 is elevated relative to rim 546 such that hub 544 is closer to the heel region of the upper.

The flexible members shown in FIGS. 9–12 are variations of flexible member 540 shown in FIG. 8. Flexible member 550 shown in FIG. 9 is identical in structure to flexible member 540, but includes webbing 552 covering the top

surface of flexible member **550** and joining each of spokes **562** to reinforce flexible member **550**. Webbing **552** may be injection molded with the rest of flexible member. Flexible member **560** shown in FIG. **10** is similar in structure to flexible member **540** shown in FIG. **8**; however, spokes **562** decrease in thickness between hub **564** and the central portion of each of the spokes **562** and then increase in thickness from the central portion toward rim **566**.

Flexible member **570**, shown in FIG. **11**, also includes a plurality of spokes **572** joined at opposite ends to hub **574** and rim **576**. In this embodiment, the thickness of the spokes decreases in a direction from hub **574** toward rim **576**. In addition, webbing **578** may be placed over the top surface of flexible member **570** similar to that disclosed in FIG. **9**.

FIG. **12** illustrates a housing **580** for supporting the flexible member, in this example, flexible member **560**. Housing **580** has an L-shaped cross-section to support the bottom and side surfaces of rim **566**. Housing **580** may be inserted into the shoe heel with flexible member **560** or may be permanently affixed to the rear sole support. In either case, housing **580** acts as a reinforcement for limiting or eliminating lateral movement of flexible member **560** during use. This may have the effect of making the center of the flexible member more springy. It may also allow the member to be made of thinner and/or lighter weight material.

FIGS. **13** and **14** show further variations of flexible plate **500** shown in FIG. **4**. While flexible plate **500** has a generally uniform thickness at any given radius, flexible plate **585** shown in FIG. **13** decreases in thickness from the center of the member toward its periphery. Flexible member **590** shown in FIG. **14**, on the other hand, is thicker near the center and at the periphery, but thinner therebetween.

FIGS. **15–17A** disclose flexible members composed of carbon ribbons set in a resin binder. Alternatively, they may be fiberglass ribbons or a combination of carbon and fiberglass ribbons. Ribbons made of other types of fiber may also be used. Flexible member **600** includes radially or diametrically projecting ribbons **602**, either emanating from the center of flexible member toward its periphery or, preferably, passing through the center from a point on the periphery to a diametrically opposite point on the periphery. These ribbons **602** are fixed in position by a resin binder **604** known in the art. Flexible member **610** shown in FIG. **16** also includes carbon ribbons **602** set in a resin binder **604**, but further includes a rim **606** comprised of ribbon preset in the resin binder and defining the periphery of flexible member **610**. Flexible member **620** shown in FIG. **17** is identical to flexible member **610** shown in FIG. **16** except that it further includes a circular ribbon **608** disposed in resin binder **604** and circumscribing the center of flexible member **620**. The flexible member shown in FIG. **17A** is identical to the flexible member **610** shown in FIG. **17** except that it has fewer spokes and further includes a plurality of circular ribbons **608** spaced radially from the center of the member and disposed in the resin binder **604**. Flexible members **600**, **610**, and **620** may be convex in shape so that the center of the flexible member is raised relative to its outer perimeter, when placed in the shoe. They may also have a U-shaped cushioning member placed on or secured to their top surface like that shown in FIG. **18**.

Since it is contemplated that the flexible member will be composed of graphite or other stiff, but flexible, material, it is preferable to cushion the impact of the user's heel against the flexible member during use. As shown in FIG. **18**, a substantially U-shaped cushioning member **650** is disposed on the top surface of flexible member **500** to cushion the heel

upon impact. The U-shaped cushioning member is shaped to generally conform to the shape of the user's heel. Thus, the open end of the U-shape is oriented toward the front of the shoe. Cushioning member **650** may be composed of polyurethane or EVA or may be an air-filled or gel-filled member. Cushioning member **650** can be affixed to flexible member **500** by gluing, or may be made integral with flexible member **500** in an injection molding process. If injection molded, cushioning member **650** would be made of the same material as flexible member **500**. To decrease the stiffness of cushioning member **650** in this instance, small holes (not shown) may be drilled in cushioning member **650** to weaken it and thereby allow it to depress more readily upon impact and more uniformly with flexible member **500**.

The cushioning member **650** described above can be incorporated into a shoe having any of the various flexible regions disclosed in this application and drawings, as well as other shoes falling within the scope of the claims.

If cushioning member **650** is used, the shoe sock liner, which generally provides cushioning, may be thinner in the heel area or may terminate at the forward edge of cushioning member **650**. If cushioning member **650** is not used, the sock liner may extend to the rear of the shoe and may be shaped to conform to the user's heel on its top surface and the flexible member on its bottom surface. Its bottom surface may also compensate for gaps formed by the flexible member. For example, the sock liner may have a concave bottom surface in the heel area to correspond to those flexible members having convex upper surfaces.

In each of the above described embodiments, the flexible member is illustrated as a separate component of the shoe which can be removed from the shoe and replaced by a similar or different flexible member, as desired. In each of the embodiments the central portion of the flexible member is raised relative to its outer perimeter so that when placed in the shoe, the interior portion in its normal state does not touch the rear sole support and/or rear sole. As a result, the interior of the flexible member will flex in response to the user's stride without first, if ever, contacting the rear sole support and/or rear sole. Such flexible member, therefore, can be used with rear soles that have a flat upper surface, as well as those that have a concave upper surface. The relative shape and positioning of the flexible member and the adjacent rear sole support or rear sole can be designed to provide the optimum flex, stiffness, and spring characteristics. However, each of the above-described flexible members may be made integral with the rear sole support, which not only decreases the number of loose parts and increases the efficiency of the manufacturing process, but also further limits the lateral displacement of the periphery of the flexible member upon deflection, potentially creating more spring in the center and/or permitting the use of thinner and/or lighter weight material.

As shown in FIG. **19**, rear sole support **340** is identical in structure to rear sole support **140** shown in FIG. **2** except that rear sole support **340** has a flexible region **700** that serves the same purpose and function as any of the above-described flexible members. In fact, any of the above-described flexible members may be used as flexible region **700** so long as they can be made integral with rear sole support **340**. In this example, flexible region **700** is convex in shape and thus similar to flexible member **500** shown in FIG. **4**. Cushioning member **650** or a modified sock liner as described above may also be used.

The flexible region may be incorporated into other rear sole support embodiments as well. As an alternative to using

arch extension **180**, rear sole support **440** shown in FIGS. **20–22** includes a thickened tongue **447** that extends toward the ball of the foot. Thickened tongue **447** provides additional gluing surface for attaching the rear sole support to forward sole **160** and additional stiffness to the heel portion of the shoe and the arch area, thus mining the chances of separation of the forward sole from the rear sole support, and at the same time minimizing the tendency of the shoe to curl at the juncture of the hard rear sole support with the soft forward sole. Similar to rear sole support **240**, rear sole support **440** includes a heel counter **442** and a side wall **444**. Rear sole support **440** also includes a rim **448** and anchors **452** to receive and retain a rear sole with a mating groove, such as rear sole **250**. Forward sole **260** is longer in this embodiment to extend back to the edge where it would abut the rear sole. Flexible region **710** is identical to flexible region **700** in FIG. **19**.

In another embodiment, rear sole support **460**, as shown in FIGS. **23** and **24**, includes a tongue **462** that is tinner and slightly smaller than tongue **447** shown in FIGS. **20–22**. However, rear sole support **460** includes a curved wall **464** that has a pocket formed on its forward side for receiving a rating rear edge of forward sole **360** adjacent the rear sole support. Curved wall **464** provides a firm, smoothly contoured transition from hard-to-align resilient materials of the forward and rear soles and thereby minimizes gapping. It also provides a desirable brace or bumper for the lower portion of the rear sole when the user is running. Flexible region **720** is identical to flexible regions **700** and **710**.

As shown in FIGS. **25** and **26**, the flexible member may also be integrated with the securing member. Securing member **750** is similar in structure and function as securing member **400** in that it includes a wall **752** with a threaded outer surface, an inwardly and outwardly extending rim **754**, and anchors **756**. Securing member **750** also includes a convex flexible region **760** integral with wall **752**. Flexible region **760**, like flexible regions **700** and **710**, may incorporate any of the configurations shown in FIGS. **4–18**.

Securing member **750** is simply substituted for securing member **400** and flexible member **200** shown in FIG. **3** to attach rear sole **250** to rear sole support **240**. However, since sec g member **750** does not include mating ends **416**, **418**, rear sole **250** is press-fitted into securing member **70** until rear sole groove **2154** mates with securing member rim **754**. This may have the effect of making the center of the flexible member more springy. It may also allow the flexible member to be made of thinner and/or lighter weight material.

It will be apparent to those skilled in the art that various modifications and variations can be made in the system of the present invention without departing from the scope or spirit of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the claims and their equivalents.

What is claimed is:

1. A shoe comprising:

an upper having a heel region;

a rear sole having a rearward portion and an opposite forward portion connected below the heel region, the rear sole having a bottom surface at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least three portions non-planar with the at least one substantially planar portion, the non-planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface in a direction toward the perimeter of the rear sole, one of the at least three non-planar portions being proximate the rearward portion of the rear sole, and at least two of the at least three non-planar portions being proximate the forward portion of the rear sole and being oriented so that at least one edge of one of the at least two non-planar portions proximate the forward portion of the rear sole is proximate a medial side of the rear sole and at least one edge of the other of the at least two non-planar portions proximate the forward portion of the rear sole is proximate a lateral side of the rear sole;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least a portion of the upper surface of the plate being convex, at least a portion of the lower surface of the plate being concave, the interior portion of the plate being positioned over a void; and

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate, the opening being in communication with the void to expose the interior portion of the plate from outside of the shoe.

2. The shoe of claim **1**, wherein each of the non-planar portions has a maximum linear dimension less than the greatest width of the bottom surface along a line perpendicular to a major axis of the shoe.

3. The shoe of claim **1**, wherein the bottom surface includes an outsole material that is ground engaging, the rear sole including midsole material above the outsole material, at least a portion of the midsole material above the non-planar portions being thinner than the midsole material above the at least one substantially planar portion of the bottom surface of the rear sole.

4. The shoe of claim **1**, further comprising at least one wall proximate at least a portion of the peripheral portions of the plate and extending in at least one of an upwardly direction and a downwardly direction from the plate, the at least one wall being integral with the plate.

5. The shoe of claim **1**, wherein the upper has an arch region, and further comprising an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper.

6. The shoe of claim **5**, wherein the arch bridge has a bottom surface that is at least in part visible from outside of the shoe.

7. The shoe of claim **1**, wherein the upper surface has at least two convex portions, at least a portion of the upper surface being concave, the concave portion of the upper surface being located between the two convex portions of the upper surface.

8. The shoe of claim **1**, further comprising at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

9. The shoe of claim **1**, wherein at least a substantial portion of the peripheral portions of the flexible plate is

restrained from movement relative to the interior portion of the flexible plate.

10. The shoe of claim **1**, wherein the peripheral portions of the flexible plate being restrained from movement relative to the interior portion are at a point along a medial side and at a point along a lateral side of the shoe.

11. The shoe of claim **1**, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

12. The shoe of claim **1**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the user's heel.

13. The shoe of claim **12**, wherein upon the deflection of the interior portion of the plate, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe are displaceable in a direction substantially parallel to the ground.

14. The shoe of claim **1**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and at least a portion of a rearward facing portion of the peripheral portions of the flexible plate.

15. The shoe of claim **1**, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

16. The shoe of claim **15**, wherein the peripheral portions are both toward the front of the shoe.

17. The shoe of claim **15**, wherein the peripheral portions are both toward the back of the shoe.

18. The shoe of claim **15**, wherein the peripheral portions are both on the lateral side of the shoe.

19. The shoe of claim **15**, wherein the peripheral portions are both on the medial side of the shoe.

20. The shoe of claim **15**, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

21. The shoe of claim **20**, where the capable of being deflected interior portion is located between the portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

22. A shoe comprising:

an upper having a heel region and an arch region;

a rear sole having a bottom surface, the rear sole being secured below the heel region of the upper;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least a portion of the upper surface of the plate being convex, at least a portion of the lower surface of the plate being concave, the interior portion of the plate being positioned over a void;

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate, the opening being in communication with the void to expose the interior portion of the plate from outside of the shoe;

an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper, and

at least one wall proximate at least a portion of the peripheral portions of the plate and extending in at least one of an upwardly direction and a downwardly direction from the plate, the at least one wall being integral with the plate.

23. The shoe of claim **22**, wherein the at least one wall extends in an upwardly direction.

24. The shoe of claim **23**, wherein the upwardly extending wall is connected to at least a portion of the heel region of the upper.

25. The shoe of claim **23**, wherein at least a portion of the upwardly extending wall is visible from outside of the shoe.

26. The shoe of claim **25**, wherein at least a portion of the upwardly extending wall is visible from a medial side of the shoe, from a lateral side of the shoe, and from a rear of the shoe.

27. The shoe of claim **23**, wherein the at least one wall includes a wall extending in a downwardly direction.

28. The shoe of claim **27**, wherein the downwardly extending wall contacts at least a portion of the rear sole.

29. The shoe of claim **27**, wherein at least a portion of the downwardly extending wall is visible from outside of the shoe.

30. The shoe of claim **29**, wherein at least a portion of the downwardly extending wall is visible from a medial side of the shoe, from a lateral side of the shoe, and from a rear of the shoe.

31. The shoe of claim **22**, wherein the at least one wall extends in a downwardly direction.

32. The shoe of claim **31**, wherein the downwardly extending wall contacts at least a portion of the rear sole.

33. The shoe of claim **31**, wherein at least a portion of the downwardly extending wall is visible from outside of the shoe.

34. The shoe of claim **22**, wherein the arch bridge is integral with an upwardly extending wall on at least one of a lateral side and a medial side of the shoe.

35. The shoe of claim **34**, wherein the upwardly extending wall is at least in part visible from outside of the shoe.

36. The shoe of claim **22**, wherein the arch bridge has a bottom surface that is at least in substantial part visible from outside of the shoe.

37. The shoe of claim **36**, wherein the bottom surface of the arch bridge is visible on a line perpendicular to a major axis of the shoe across a width of the arch bridge.

38. The shoe of claim **22**, wherein the arch bridge is integral with a downwardly extending wall.

39. The shoe of claim **38**, wherein at least a portion of the downwardly extending wall is visible from outside of the shoe.

40. The shoe of claim **38**, wherein the downwardly extending wall contacts at least a portion of the rear sole.

41. The shoe of claim **38**, wherein the downwardly extending wall is integral with a rearward portion of the arch bridge.

42. The shoe of claim **38**, wherein the downwardly extending wall is arcuate.

43. The shoe of claim **38**, wherein the downwardly extending wall is at least in pad acurate

44. The shoe of claim 38, wherein the downwardly extending wall is curved.

45. The shoe of claim 38, wherein the downwardly extending wall is at least in part curved.

46. The shoe of claim 22, wherein the rear sole has a rearward portion and an opposite forward portion connected below the heel region, the rear sole having a bottom surface at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least two portions non-planar with the at least one substantially planar portion, the non- planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface in a direction toward the perimeter of the rear sole, one of the at least two non-planar portions being proximate the rearward portion of the rear sole, and the other of the at least two non-planar portions being proximate the forward portion of the rear sole.

47. The shoe of claim 22, wherein the upper surface has at least two convex portions, at least a portion of the upper surface being concave, the concave portion of the upper surface being located between the two convex portions of the upper surface.

48. The shoe of claim 22, further comprising at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

49. The shoe of claim 22, wherein at least a substantial portion of the peripheral portions of the flexible plate is restrained from movement relative to the interior portion of the flexible plate.

50. The shoe of claim 22, wherein the peripheral portions of the flexible plate being restrained from movement relative to the interior portion are at a point along a medial side and at a point along a lateral side of the shoe.

51. The shoe of claim 22, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

52. The shoe of claim 22, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the users heel.

53. The shoe of claim 52, wherein upon the deflection of the interior portion of the plate, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe are displaceable in a direction substantially parallel to the ground.

54. The shoe of claim 22, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and at least a portion of a rearward facing portion of the peripheral portions of the flexible plate.

55. The shoe of claim 22, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

56. The shoe of claim 55, wherein the peripheral portions are both toward the front of the shoe.

57. The shoe of claim 55, wherein the peripheral portions are both toward the back of the shoe.

58. The shoe of claim 55, wherein the peripheral portions are both on the lateral side of the shoe.

59. The shoe of claim 55, wherein the peripheral portions are both on the medial side of the shoe.

60. The shoe of claim 55, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

61. The shoe of claim 60, wherein the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

62. A shoe comprising:

an upper having a heel region;

a rear sole having a bottom surface, the rear sole being secured below the heel region of the upper,

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least a portion of the upper surface of the plate being convex, at least a portion of the lower surface of the plate being concave, the interior portion of the plate being positioned over a void;

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate, the opening being in communication with the void to expose the interior portion of the plate from outside of the shoe, and

at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

63. The shoe of claim 62, wherein the at least one hole includes at least two holes, at least one of the at least two holes being on the medial side of the shoe and at least one of the at least two holes being on the lateral side of the shoe.

64. The shoe of claim 63, wherein the plate is at least in pad visible through both of the at least two holes.

65. The shoe of claim 62, wherein the plate is at least in part visible through the at least one hole.

66. The shoe of claim 62, wherein the at least one sidewall has an interior surface, the void being defined at least in part by the interior surface of the at least one sidewall.

67. The shoe of claim 66, wherein the void is at least in part visible through the at least one hole.

68. The shoe of claim 67, wherein at least one hole includes at least two holes, at least one of the at least two holes being on the medial side of the shoe and at least one of the at least two holes being on the lateral side of the shoe, the void being at least in part visible through both of the at least two holes.

69. The shoe of claim 66, wherein the interior surface of the at least one sidewall is visible through the opening in the bottom surface of the rear sole.

70. The shoe of claim 66, wherein at least a portion of the interior surface of the at least one sidewall is visible through the at least one hole in the at least one sidewall.

71. The shoe of claim 66, wherein the at least one hole in the at least one sidewall is on the lateral side of the shoe, the interior surface of the at least one sidewall on the medial side of the shoe being visible through the at least one hole.

72. The shoe of claim 62, wherein the at least one sidewall includes midsole material.

73. The shoe of claim 62, wherein the at least one sidewall includes outsole material.

74. The shoe of claim 62, wherein the at least one sidewall includes both midsole material and outsole material.

75. The shoe of claim 62, further comprising at least one wall proximate at least a portion of the peripheral portions of the plate and extending in at least one of an upwardly direction and a downwardly direction from the plate, the at least one wall being integral with the plate.

76. The shoe of claim 62, wherein the upper has an arch region, and further comprising an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper.

77. The shoe of claim 76, wherein the arch bridge has a bottom surface that is at least in part visible from outside of the shoe.

78. The shoe of claim 62, wherein the rear sole has a rearward portion and an opposite forward portion connected below the heel region, the rear sole having a bottom surface at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least two portions non-planar with the at least one substantially planar portion, the non- planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface on a direction toward the perimeter of the rear sole, one of the at least two non-planar portions being proximate the rearward portion of the rear sole, and the other of the at least two non-planar portions being proximate the forward portion of the rear sole.

79. The shoe of claim 62, wherein the upper surface has at least two convex portions, at least a portion of the upper surface being concave, the concave portion of the upper surface being located between the two convex portions of the upper surface.

80. The shoe of claim 62, wherein at least a substantial portion of the peripheral portions of the flexible plate is restrained from movement relative to the interior portion of the flexible plate.

81. The shoe of claim 62, wherein the peripheral portions of the flexible plate being restrained from movement relative to the interior portion are at a point along a medial side and at a point along a lateral side of the shoe.

82. The shoe of claim 62, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

83. The shoe of claim 62, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the user's heel.

84. The shoe of claim 83, wherein upon the deflection of the interior portion of the plate, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe are displaceable in a direction substantially parallel to the ground.

85. The shoe of claim 62, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and at least a portion of a rearward facing portion of the peripheral portions of the flexible plate.

86. The shoe of claim 62, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

87. The shoe of claim 86, wherein the peripheral portions are both toward the front of the shoe.

88. The shoe of claim 86, wherein the peripheral portions are both toward the back of the shoe.

89. The shoe of claim 86, wherein the peripheral portions are both on the lateral side of the shoe.

90. The shoe of claim 86, wherein the peripheral portions are both on the medial side of the shoe.

91. The shoe of claim 86, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

92. The shoe of claim 91, wherein the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

93. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region of the upper; and

a flexible plate having upper and lower surfaces and positioned between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, the upper surface having at least one concave portion, and the lower surface being at least in part visible from outside of the shoe.

94. The shoe of claim 93, wherein the lower surface is at least in part visible through an opening in the rear sole.

95. The shoe of claim 93, wherein the upper surface has at least one convex portion, the at least one convex portion being adjacent the at least one concave portion of the upper surface.

96. The shoe of claim 95, wherein the upper surface has at least two convex portions, the concave portion of the upper surface being located between the convex portions of the upper surface.

97. The shoe of claim 96, further comprising at least one wall proximate at least a portion of the peripheral portions of the plate and extending in at least one of an upwardly direction and a downwardly direction from the plate, the at least one wall being integral with the plate.

98. The shoe of claim 96, wherein the upper has an arch region, and further comprising an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper, the arch bridge having a bottom surface that is at least in part visible from outside of the shoe.

99. The shoe of claim 96, wherein the rear sole has a rearward portion and an opposite forward portion connected

below the heel region, the rear sole having a bottom surface at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least two portions non-planar with the at least one substantially planar portion, the non- planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface in a direction toward the perimeter of the rear sole, one of the at least two non-planar portions being proximate the rearward portion of the rear sole, and the other of the at least two non-planar portions being proximate the forward portion of the rear sole.

100. The shoe of claim **93**, further comprising at least one wall extending in at least one of an upwardly direction and a downwardly direction, the at least one wall being integral with at least a portion of the peripheral portions of the plate.

101. The shoe of claim **93**, wherein the upper has an arch region, and further comprising an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper, the arch bridge further having a bottom surface that is at least in part visible from outside of the shoe.

102. The shoe of claim **93**, wherein the rear sole has a rearward portion and an opposite forward portion connected below the heel region, the rear sole having a bottom surface at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least two portions non-planar with the at least one substantially planar portion, the non- planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface in a direction toward the perimeter of the rear sole, one of the at least two non-planar portions being proximate the rearward portion of the rear sole, and the other of the at least two non-planar portions being proximate the forward portion of the rear sole.

103. The shoe of claim **93**, further comprising at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

104. The shoe of claim **93**, wherein at least a substantial portion of the peripheral portions of the flexible plate is restrained from movement relative to the interior portion of the flexible plate.

105. The shoe of claim **93**, wherein the peripheral portions of the flexible plate being restrained from movement relative to the interior portion are at a point along a medial side and at a point along a lateral side of the shoe.

106. The shoe of claim **93**, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

107. The shoe of claim **93**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the user's heel.

108. The shoe of claim **107**, wherein upon the deflection of the interior portion of the plate, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe are displaceable in a direction substantially parallel to the ground.

109. The shoe of claim **93**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate.

110. The shoe of claim **93**, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

111. The shoe of claim **110**, wherein the peripheral portions are both toward the front of the shoe.

112. The shoe of claim **110**, wherein the peripheral portions are both toward the back of the shoe.

113. The shoe of claim **110**, wherein the peripheral portions are both on the lateral side of the shoe.

114. The shoe of claim **110**, wherein the peripheral portions are both on the medial side of the shoe.

115. The shoe of claim **110**, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

116. The shoe of claim **115**, wherein the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

117. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region of the upper;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least one portion of a cross section of the plate perpendicular to a major axis of the shoe defining a curve in a direction generally from a medial side of the shoe to a lateral side of the shoe; and

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate that exposes the interior portion of the plate.

118. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region of the upper;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least one portion of a cross section of the plate parallel to the major axis of the shoe defining a curve in a direction generally from a front of the shoe to a back of the shoe; and

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate that exposes the interior portion of the plate.

119. The shoe of claim **118**, wherein the upper surface has at least two convex portions, at least a portion of the upper surface being concave, the concave portion of the upper surface being located between the two convex portions of the upper surface.

120. The shoe of claim **118**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the user's heel, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe being displaceable in a direction substantially parallel to the ground upon the deflection of the interior portion of the plate.

121. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region of the upper;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least one portion of a cross section of the plate perpendicular to a major axis of the shoe defining a curve in a direction generally from a medial side of the shoe to a lateral side of the shoe, at least one portion of a cross section of the plate parallel to the major axis of the shoe defining a curve in a direction generally from a front of the shoe to a back of the shoe, and

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate that exposes the interior portion of the plate.

122. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region and having a rearward portion, the rear sole further having a bottom surface at least a portion of which is ground engaging, the ground-engaging portion of the bottom surface including at least one substantially planar portion and at least one portion non-planar with the at least one substantially planar portion, the at least one non-planar portion being positioned proximate a perimeter of the bottom surface and inclined upwardly in a direction toward the perimeter of the bottom surface from another portion of the bottom surface, the at least one non-planar portion having an outer edge coincident with the perimeter of the bottom surface and being located proximate the rearward portion of the rear sole;

a flexible plate having upper and lower surfaces and positioned between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, the upper surface of the plate being in at least substantial pad concave in shape, the interior portion of the plate being positioned over a void, and the lower surface of the plate being at least in part visible from outside of the shoe; and

a sidewall that includes midsole material located beneath the plate, the sidewall having an exterior surface that is at least in part visible from outside the shoe and an interior surface that at least partially defines the void, the sidewall further having at least one opening therethrough on at least one of a lateral side of the shoe, a medial side of the shoe, and a rear of the shoe.

123. The shoe of claim **122**, wherein the at least one opening is on both a medial side of the shoe and a lateral side of the shoe.

124. The shoe of claim **122**, wherein at least one opening is on both a medial side of the shoe and a lateral side of the shoe, and on a rear of the shoe.

125. The shoe of claim **122**, wherein the void is visible at least in part from outside the shoe through the at least one opening in the sidewall.

126. The shoe of claim **122**, wherein the lower surface of the plate is visible at least in part from outside the shoe through the at least one opening in the sidewall.

127. The shoe of claim **122**, wherein the interior surface of the sidewall is visible at least in part from outside the shoe through the at least one opening in the sidewall.

128. The shoe of claim **122**, wherein at least one portion of a cross section of the plate perpendicular to a major axis of the shoe defines a curve in a direction generally from a medial side of the shoe to a lateral side of the shoe, at least one portion of a cross section of the plate parallel to the major axis of the shoe defining a curve in a direction generally from a front of the shoe to a back of the shoe.

129. The shoe of claim **122**, wherein the at least one non-planar portion has a maximum linear dimension less than the greatest width of the bottom surface along a line perpendicular to a major axis of the shoe.

130. The shoe of claim **122**, wherein the bottom surface includes an outsole material that is ground engaging, the rear sole including midsole material above the outsole material, at least a portion of the midsole material above the at least one non-planar portion being thinner than the midsole material above the at least one substantially planar portion of the bottom surface of the rear sole.

131. The shoe of claim **122**, wherein the plate has at least one opening therein.

132. The shoe of claim **131**, wherein the at least one opening has a center located beneath the approximate center of the heel of the user.

133. The shoe of claim **132**, wherein the plate has multiple elongated cut-out portions therethrough.

134. The shoe of claim **133**, wherein the elongated cut-out portions are oriented around the center of the opening.

135. The shoe of claim **134**, wherein the elongated cut-out portions are evenly spaced around the center of the opening.

136. The shoe of claim **135**, wherein the elongated cut-out portions have a length and are oriented around the center of the opening such that the length is in a direction away from the center of the opening and toward the periphery of the plate.

137. The shoe of claim **136**, wherein a mid-longitudinal axis along the length of the elongated cut-out portions passes through the approximate center of the opening.

138. The shoe of claim 122, wherein a portion of the interior portion of the plate is thinner than a portion of the peripheral portions of the plate.

139. The shoe of claim 137, wherein the elongated cut-out portions are spaced around the center of the opening in a star-like pattern.

140. The shoe of claim 127, wherein the plate has six elongated cut-out portions around the center of the opening, the cut-out portions being oriented around the center of the opening in 60-degree increments.

141. The shoe of claim 131, wherein the at least one opening in the plate is at least in part visible from outside the shoe.

142. The shoe of claim 122, wherein the non-planar portion of the ground-engaging portion of the bottom surface of the rear sole includes an interior edge, the interior edge being located proximate an opening in the ground-engaging portion of the bottom surface.

143. The shoe of claim 142, wherein the interior edge is at least in part curved.

144. The shoe of claim 142, wherein the interior edge is at least in part arc-shaped.

145. The shoe of claim 142, wherein the interior edge defines at least a portion of a circle.

146. The shoe of claim 142, wherein the opening is substantially circular in shape.

147. The shoe of claim 142, wherein the rear sole has an interior sidewall adjacent and extending upwardly from the interior edge of the non-planar portion of the ground-engaging portion of the bottom surface.

148. The shoe of claim 142, wherein the interior edge defines a thickness of a layer of an outsole material, the outsole layer having an upper surface and a lower surface, the upper surface contacting another portion of the rear sole and the lower surface comprising at least a portion of the bottom surface of the rear sole.

149. The shoe of claim 142, wherein the opening in the ground-engaging portion of the bottom surface exposes a wall that defines, at least in part, a truncated cone.

150. The shoe of claim 122, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion along at least a substantial portion of the peripheral portions.

151. The shoe of claim 122, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at a point along a medial side and at a point along a lateral side of the shoe.

152. The shoe of claim 122, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

153. The shoe of claim 122, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both at a point along a medial side and at a point along a lateral side of the shoe and along a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate.

154. The shoe of claim 122, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and at least a portion of a rearward facing portion of the peripheral portions of the flexible plate.

155. The shoe of claim 122, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

156. The shoe of claim 155, wherein the peripheral portions are both toward the front of the shoe.

157. The shoe of claim 155, wherein the peripheral portions are both toward the back of the shoe.

158. The shoe of claim 155, wherein the peripheral portions are both on the lateral side of the shoe.

159. The shoe of claim 155, wherein the peripheral portions are both on the medial side of the shoe.

160. The shoe of claim 155, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

161. The shoe of claim 160, where the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

162. A shoe comprising:

an upper having a heel region and an arch region;

a rear sole having a rearward portion and an opposite forward portion connected below the heel region, the rear sole having a bottom surface, at least a portion of which is ground engaging, the bottom surface including at least one substantially planar portion and at least two portions non-planar with the at least one substantially planar portion, the non-planar portions being positioned proximate the perimeter of the rear sole and separated from each other by other portions of the bottom surface, each of the non-planar portions being inclined upwardly from another portion of the bottom surface in a direction toward the perimeter of the rear sole, one of the at least two non-planar portions being proximate the rearward portion of the rear sole, and the other of the at least two non-planar portions being proximate the forward portion of the rear sole;

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe;

an opening in the bottom surface of the rear sole located beneath the interior portion of the plate to expose the interior portion of the plate from outside of the shoe; and

an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper, the arch bridge having a bottom surface that is at least in part visible from outside of the shoe.

163. The shoe of claim 162, further including at least one wall proximate at least a portion of the peripheral portions of the plate, the at least one wall being integral with the plate and extending in a downwardly direction from the plate, the downwardly extending wall contacting at least a portion of the rear sole, at least a portion of the downwardly extending wall being visible from outside of the shoe.

164. The shoe of claim 163, further including at least one wall proximate at least a portion of the peripheral portions of the plate, the at least one wall being integral with the plate and extending in an upwardly direction from the plate, at

least a portion of the upwardly extending wall being visible from outside of the shoe..

165. The shoe of claim **162**, further including at least one wall proximate at least a portion of the peripheral portions of the plate, the at least one wall being integral with the plate and extending in an upwardly direction from the plate, at least a portion of the upwardly extending wall being visible from outside of the shoe.

166. The shoe of claim **162**, wherein a substantial portion of the bottom surface of the arch bridge is visible from outside of the shoe.

167. The shoe of claim **162**, wherein the bottom surface of the arch bridge is visible on a line perpendicular to a major axis of the shoe across a width of the arch bridge.

168. The shoe of claim **162**, wherein the arch bridge has proximate at least one of a medial side of the shoe and a lateral side of the shoe at least one wall integral with the arch bridge and extending in an upwardly direction.

169. The shoe of claim **168**, wherein at least a portion of the upwardly extending wall of the arch bridge is connected to the arch region of the upper.

170. The shoe of claim **168**, wherein at least a portion of the upwardly extending wall of the arch bridge is visible from outside of the shoe.

171. The shoe of claim **170**, wherein the arch bridge has proximate at least one of a medial side of the shoe and a lateral side of the shoe at least one wall integral with the arch bridge and extending in a downwardly direction, at least a portion of the downwardly extending wall of the arch bridge being visible from outside of the shoe.

172. The shoe of claim **162**, wherein the arch bridge has proximate at least one of a medial side of the shoe and a lateral side of the shoe at least one wall integral with the arch bridge and extending in a downwardly direction, at least a portion of the downwardly extending wall of the arch bridge being visible from outside of the shoe.

173. The shoe of claim **168**, further including at least one wall proximate at least a portion of the peripheral portions of the plate, the at least one wall being integral with the plate and extending in an upwardly direction from the plate.

174. The shoe of claim **173**, wherein the upwardly extending wall of the arch bridge is adjacent the upwardly extending wall of the plate.

175. The shoe of claim **173**, wherein the upwardly extending wall of the arch bridge is integral with the upwardly extending wall of the plate.

176. The shoe of claim **175**, wherein at least a portion of the upwardly extending wall of the arch bridge and at least a portion of the upwardly extending wall of the plate are visible from outside of the shoe.

177. The shoe of claim **162**, wherein further comprising at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

178. The shoe of claim **177**, wherein the at least one hole includes at least two holes, at least one of the at least two holes being on the medial side of the shoe and at least one of the at least two holes being on the lateral side of the shoe.

179. The shoe of claim **162**, wherein a substantial portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion of the flexible plate.

180. The shoe of claim **162**, wherein the flexible plate has substantially its entire peripheral portion restrained.

181. The shoe of claim **162**, wherein the peripheral portions of the flexible plate being restrained from movement relative to the interior portion are at a point along a medial side and at a point along a lateral side of the shoe.

182. The shoe of claim **162**, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

183. The shoe of claim **162**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both at a point along a medial side and a lateral side of the shoe and along a forward facing portion and a rearward facing portion of the peripheral portion of the flexible plate.

184. The shoe of claim **162**, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and a lateral side of the shoe and on at least a portion of a forward facing portion and a rearward facing portion of the peripheral portion of the flexible plate.

185. The shoe of claim **162**, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

186. The shoe of claim **185**, wherein the peripheral portions are both toward the front of the shoe.

187. The shoe of claim **185**, wherein the peripheral portions are both toward the back of the shoe.

188. The shoe of claim **185**, wherein the peripheral portions are both on the lateral side of the shoe.

189. The shoe of claim **185**, wherein the peripheral portions are both on the medial side of the shoe.

190. The shoe of claim **185**, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

191. The shoe of claim **190**, wherein the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

192. A shoe comprising:

an upper having a heel region,

a rear sole secured below the heel region of the upper; and

a flexible plate having upper and lower surfaces and supported between at least a portion of the rear sole and at least a portion of the heel region of the upper;

at least a portion of the periphery of the plate being restrained from movement in a substantially vertical direction relative to an interior portion so that the interior portion of the plate is capable of being deflected relative to at least a portion of the restrained periphery in a substantially vertical direction; and

supporting structure located proximate the plate having at least one wall extending in a downward direction to at least partially define a recess, at least a portion of the rear sole secured in the recess of the supporting structure.

193. The shoe of claim **192**, wherein the interior portion of the plate is positioned over a void.

194. The shoe of claim **193**, wherein at least one portion of a cross-section of the plate parallel to the major axis of the shoe defines a curve in a direction generally from a front of the shoe to a back of the shoe.

195. The shoe of claim **194**, wherein the plate has an upper surface with at least two convex portions, at least a portion of the upper surface being concave, the concave portion of the upper surface being located between the two convex portions of the upper surface.

196. The shoe of claim 195, wherein the portion of the periphery of the plate being restrained from movement relative to the interior portion includes at at least two spaced apart points along a medial side of the shoe and at at least two spaced apart points along a lateral side of the shoe, the interior portion of the plate being located above a point between the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe and beneath the approximate center of the users heel.

197. The shoe of claim 196, wherein upon the deflection of the interior portion of the plate, the at least two points along the medial side of the shoe and the at least two points along the lateral side of the shoe are displaceable in a direction substantially parallel to the ground.

198. The shoe of claim 196, wherein the upper has an arch region, and further comprising an arch bridge integral with the plate, the arch bridge extending from a position proximate a forward portion of the plate, forward beneath at least a portion of the arch region of the upper, the arch bridge having a bottom surface that is at least in part visible from outside of the shoe.

199. The shoe of claim 198, further comprising at least one sidewall above at least a portion of the bottom surface of the rear sole, the at least one sidewall having at least one hole therethrough located on at least one of a lateral side, a medial side, and a rear of the shoe.

200. The shoe of claim 199, further comprising at least one wall proximate at least a portion of the periphery of the plate and extending in at least one of an upwardly direction and a downwardly direction from the plate, the at least one wall being integral with the plate.

201. The shoe of claim 200, wherein at least one portion of the periphery of the plate being restrained from movement is along the upper surface of the plate and at least one other portion of the periphery of the plate being restrained from movement is along the lower surface of the plate.

202. The shoe of claim 201, wherein the portions of the periphery of the upper and lower surfaces being restrained from movement are proximate one another.

203. The shoe of claim 202, where the capable of being deflected interior portion is located between the portions of the periphery of the upper and lower surfaces being restrained and a point beneath a central portion of the heel region of the upper.

204. A shoe comprising:

an upper having a heel region;

a rear sole secured below the heel region and having rearward portion, the rear sole further having a bottom surface at least a portion of which is ground engaging, the ground-engaging portion of the bottom surface including at least one substantially planar portion and at least one portion non-planar with the at least one substantially planar portion, the at least one non-planar portion being positioned proximate a perimeter of the bottom surface and inclined upwardly in a direction toward the perimeter of the bottom surface from another portion of the bottom surface, the at least one non-planar portion having an outer edge coincident with the perimeter of the bottom surface and being located proximate the rearward portion of the rear sole;

a flexible plate having upper and lower surfaces and positioned between at least a portion of the rear sole and at least a portion of the heel region of the upper, peripheral portions of the plate being restrained from movement relative to an interior portion of the plate in a direction substantially perpendicular to a major axis of the shoe so that the interior portion of the plate is capable of being deflected relative to the peripheral portions in a direction substantially perpendicular to the major axis of the shoe, at least a portion of at least one cross-section of the plate defining a curve, the interior portion of the plate being positioned over a void, and the lower surface of the plate being at least in part visible from outside of the shoe, the plate having at least one opening therein, the at least one opening having a center located beneath the approximate center of the user's heel; and

a sidewall that includes midsole material located beneath the plate, the sidewall having an exterior surface that is at least in pad visible from outside the shoe and an interior surface that at least partially defines the void, the sidewall further having at least one opening therethrough on at least one of a lateral side of the shoe, a medial side of the shoe, and a rear of the shoe.

205. The shoe of claim 204, wherein the at least one opening in the sidewall is on both a medial side of the shoe and a lateral side of the shoe.

206. The shoe of claim 204, wherein the at least one opening in the sidewall is on both a medial side of the shoe and a lateral side of the shoe, and on a rear of the shoe.

207. The shoe of claim 204, wherein the void is visible at least in part from outside the shoe through the at least one opening in the sidewall.

208. The shoe of claim 204, wherein the lower surface of the plate is visible at least in part from outside the shoe through the at least one opening in the sidewall.

209. The shoe of claim 204, wherein the interior surface of the sidewall is visible at least in part from outside the shoe through the at least one opening in the sidewall.

210. The shoe of claim 204, wherein the at least one non-planar portion has a maximum linear dimension less than the greatest width of the bottom surface along a line perpendicular to a major axis of the shoe.

211. The shoe of claim 204, wherein the bottom surface includes an outsole material that is ground engaging, the rear sole including midsole material above the outsole material, at least a portion of the midsole material above the at least one non-planar portion being thinner than the midsole material above the at least one substantially planar portion of the bottom surface of the rear sole.

212. The shoe of claim 204, wherein the plate has multiple elongated cut-out portions therethrough.

213. The shoe of claim 212, wherein the elongated cut-out portions are oriented around the center of the opening.

214. The shoe of claim 213, wherein the elongated cut-out portions are evenly spaced around the center of the opening.

215. The shoe of claim 214, wherein the elongated cut-out portions have a length and are oriented around the center of the opening such that the length is in a direction away from the center of the opening and toward the periphery of the plate.

216. The shoe of claim 215, wherein a mid-longitudinal axis along the length of the elongated cut-out portions passes through the approximate center of the opening.

217. The shoe of claim 204, wherein a portion of the interior portion of the plate is thinner than a portion of the peripheral portions of the plate.

218. The shoe of claim 216, wherein the elongated cut-out portions are spaced around the center of the opening in a star-like pattern.

219. The shoe of claim 216, wherein the plate has six elongated cut-out portions around the center of the opening, the cut-out portions being oriented around the center of the opening in 60-degree increments.

220. The shoe of claim 204, wherein the at least one opening in the plate is at least in part visible from outside the shoe.

221. The shoe of claim 204, wherein the non-planar portion of the ground-engaging portion of the bottom surface of the rear sole includes an interior edge, the interior edge being located proximate an opening in the ground-engaging portion of the bottom surface.

222. The shoe of claim 221, wherein the interior edge is at least in part curved.

223. The shoe of claim 221, wherein the interior edge is at least in part arc-shaped.

224. The shoe of claim 221, wherein the interior edge defines at least a portion of a circle.

225. The shoe of claim 221, wherein the opening is substantially circular shape.

226. The shoe of claim 221, wherein the rear sole has an interior sidewall adjacent and extending upwardly from the interior edge of the non-planar portion of the ground-engaging portion of the bottom surface.

227. The shoe of claim 221, wherein the interior edge defines a thickness of a layer of an outsole material, the outsole layer having an upper surface and a lower surface, the upper surface contacting another portion of the rear sole and the lower surface comprising at least a portion of the bottom surface of the rear sole.

228. The shoe of claim 221, wherein the opening in the ground-engaging portion of the bottom surface exposes a wall that defines, at least in part, a truncated cone.

229. The shoe of claim 204, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion at a point along a medial side and at a point along a lateral side of the shoe.

230. The shoe of claim 204, wherein a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate are restrained from movement relative to the interior portion.

231. The shoe of claim 204, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both at a point along a medial side and at a point along a lateral side of the shoe and along a forward facing portion and a rearward facing portion of the peripheral portions of the flexible plate.

232. The shoe of claim 204, wherein the peripheral portions of the flexible plate are restrained from movement relative to the interior portion both along at least a portion of a medial side and at least a portion of a lateral side of the shoe and on at least a portion of a forward facing portion and at least a portion of a rearward facing portion of the peripheral portions of the flexible plate.

233. The shoe of claim 204, wherein at least one of the peripheral portions of the plate being restrained from movement is along the upper surface of the plate and at least one of the peripheral portions of the plate being restrained from movement is along the lower surface of the plate.

234. The shoe of claim 233, wherein the peripheral portions are both toward the front of the shoe.

235. The shoe of claim 233, wherein the peripheral portions are both toward the back of the shoe.

236. The shoe of claim 233, wherein the peripheral portions are both on the lateral side of the shoe.

237. The shoe of claim 233, wherein the peripheral portions are both on the medial side of the shoe.

238. The shoe of claim 233, wherein the peripheral portions of the upper and lower surfaces are proximate one another.

239. The shoe of claim 238, wherein the capable of being deflected interior portion is located between the peripheral portions of the upper and lower surfaces and a point beneath a central portion of the heel region of the upper.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,604,300 B2
DATED : August 12, 2003
INVENTOR(S) : David F. Meschan

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [56], **References Cited**, OTHER PUBLICATIONS, insert the following:
-- AVIA 1989 Catalog excerpt.
AVIA Fall 1991 Footwear Catalog.
Runner's World 1989 Spring Shoe Survey (MIZ 135893 – MIZ 135902).
4 photographs of shoes sold in the United States prior to the filing date of the above-referenced application. --; and at the third reference, change "Etoni" to -- Etonic --.

Column 16,
Line 67, change "pad" to -- part --.

Column 17,
Line 11, change "non- planar" to -- non-planar --; and
Line 51, change "users" to -- user's --.

Column 18,
Line 47, change "pad" to -- part --.

Column 19,
Line 30, change "non- planar" to -- non-planar --.

Column 20,
Line 58, change "plate ,the" to -- plate, the --.

Column 21,
Line 5, change "non- planar" to -- non-planar --;
Line 12, change "sole." to -- sole, --; and
Line 32, change "non- planar" to -- non-planar --.

Column 24,
Line 6, change "pad" to -- part --.

Column 26,
Line 14, change "where" to -- wherein --.

Column 27,
Line 2, change "shoe.." to -- shoe. --; and
Line 51, delete "wherein".

Column 28,
Line 29, change "arc" to -- are --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,604,300 B2
DATED : August 12, 2003
INVENTOR(S) : David F. Meschan

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 29,
Line 9, change "users" to -- user's --; and
Line 40, change "where" to -- wherein --.

Column 30,
Line 13, change "pad" to -- part --.

Column 31,
Line 16, after "circular" insert -- in --.

Signed and Sealed this

Ninth Day of December, 2003

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Patent Appendix B

US006662471B2

(12) **United States Patent**
Meschan

(10) **Patent No.: US 6,662,471 B2**
(45) **Date of Patent: *Dec. 16, 2003**

(54) **ATHLETIC SHOE WITH IMPROVED HEEL STRUCTURE**

(75) Inventor: **David F. Meschan**, Greensboro, NC (US)

(73) Assignee: **Akeva, L.L.C.**, Greensboro, NC (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/419,641**

(22) Filed: **Oct. 18, 1999**

(65) **Prior Publication Data**

US 2003/0208927 A1 Nov. 13, 2003

Related U.S. Application Data

(63) Continuation of application No. 09/149,142, filed on Sep. 8, 1998, now Pat. No. 5,970,628, which is a continuation of application No. 08/542,251, filed on Oct. 12, 1995, now Pat. No. 5,806,210.

(51) **Int. Cl.**[7] **A43B 13/28**

(52) **U.S. Cl.** ..... **36/27**; 36/28; 36/35 R

(58) **Field of Search** ..... 36/42, 39, 36 R, 36/36 A, 27, 31, 35 R, 15, 37, 69, 41, 36 C, 34 R, 25 R, 100, 107, 103, 105, 38

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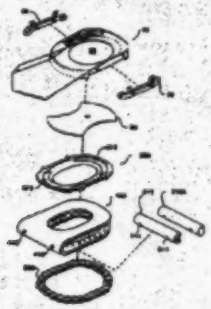
Primary Examiner—Ted Kavanaugh
(74) *Attorney, Agent, or Firm*—Martin & Ferraro, LLP

(57) **ABSTRACT**

A shoe includes a rear sole support for receiving a replaceable rear sole to provide longer wear. The shoe may also include a flexible plate supported by the rear sole support between the heel and the rear sole to reduce midsole compression and provide additional spring. A mounting member secures the rear sole to the rear sole support, and a locking member prevents rotation of the rear sole relative to the rear sole support during use. The replaceable rear sole and the flexible plate allow the shoe to be adapted to different desired performance characteristics depending upon the intended activity and terrain or playing surface.

32 Claims, 29 Drawing Sheets



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4 photographs of shoes sold in the United States prior to the filing date of the above–referenced application.

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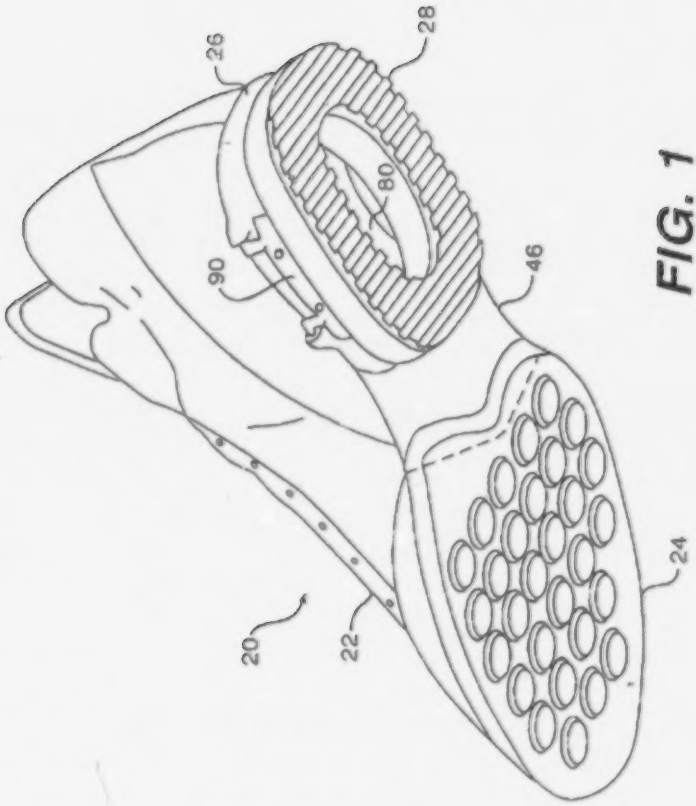


FIG. 1

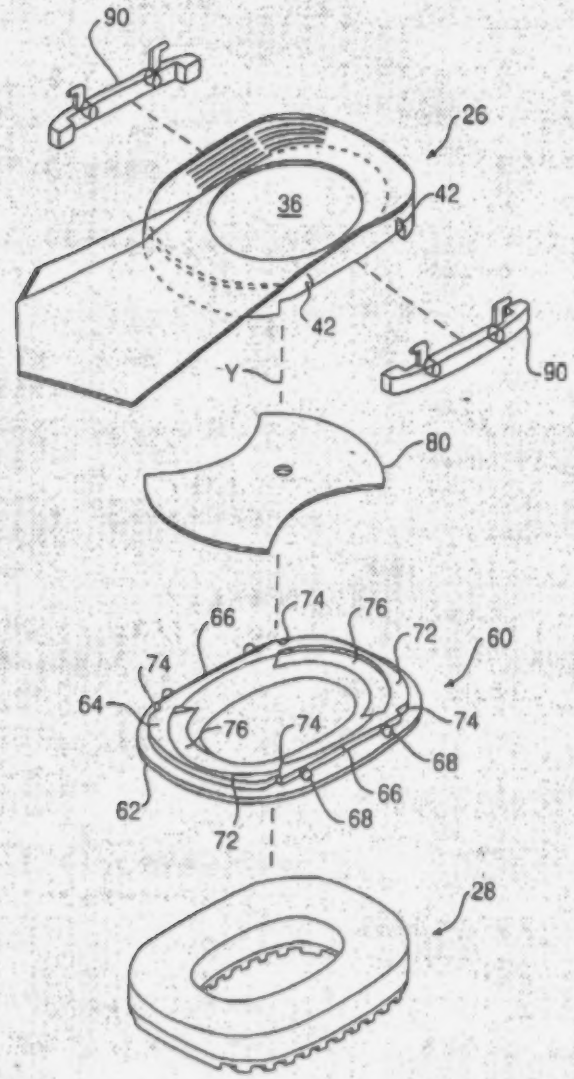
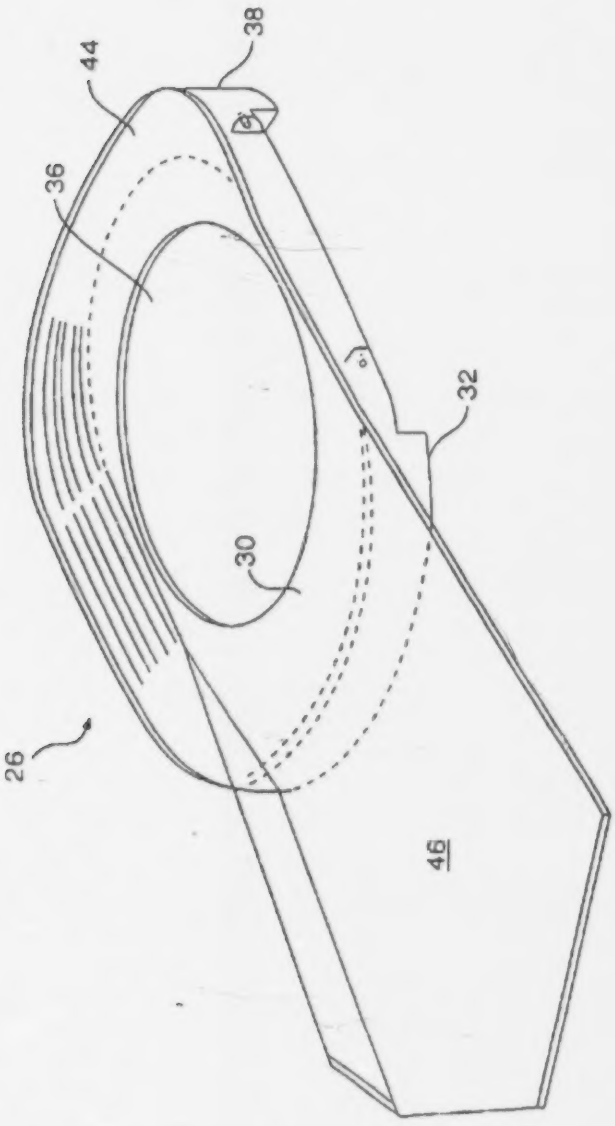


FIG. 2



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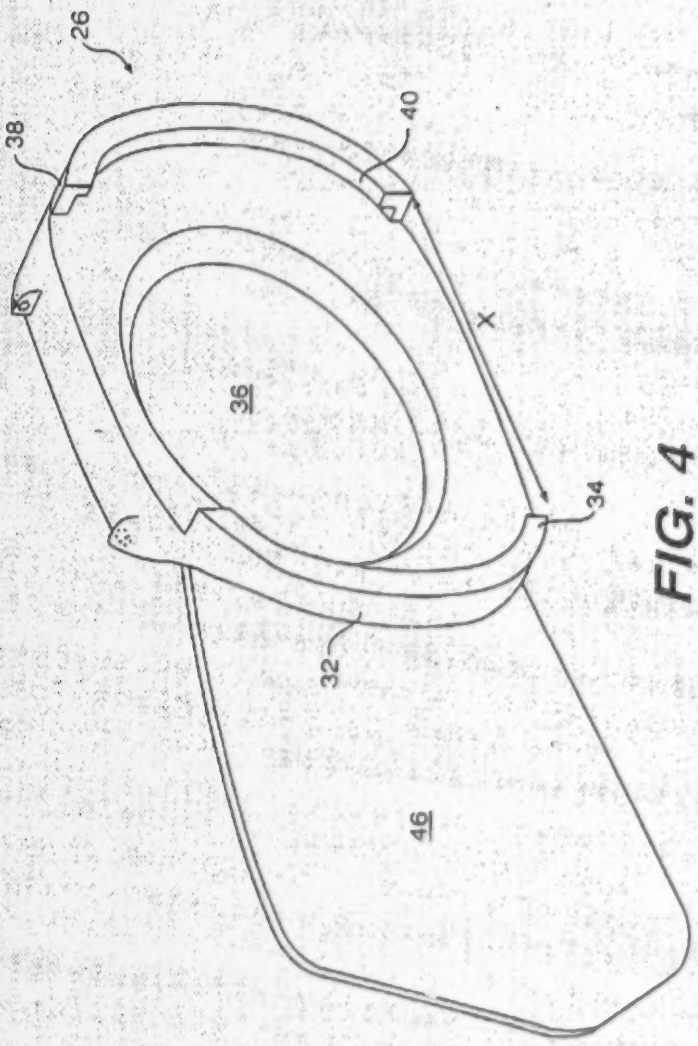


FIG. 4

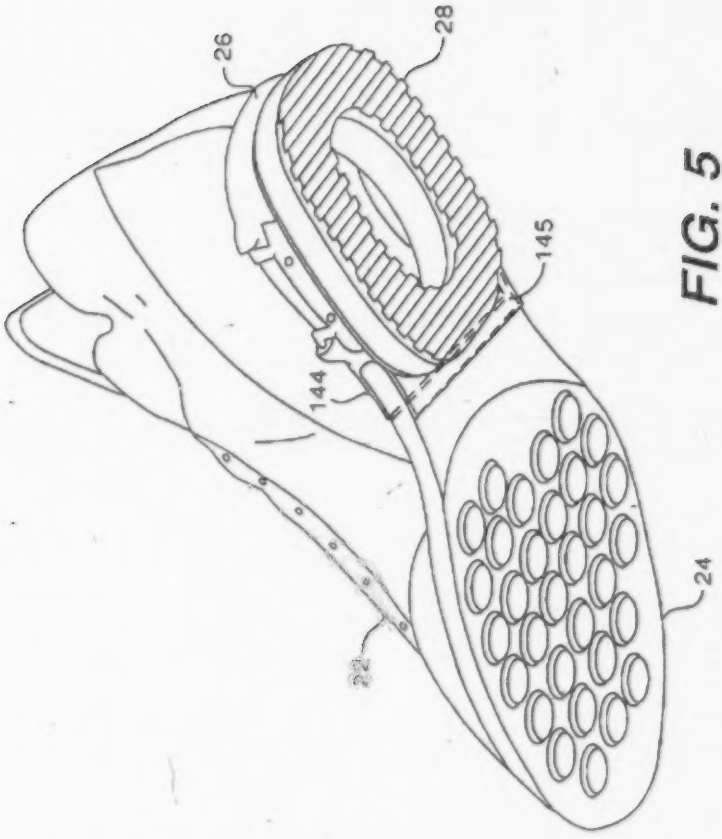


FIG. 5

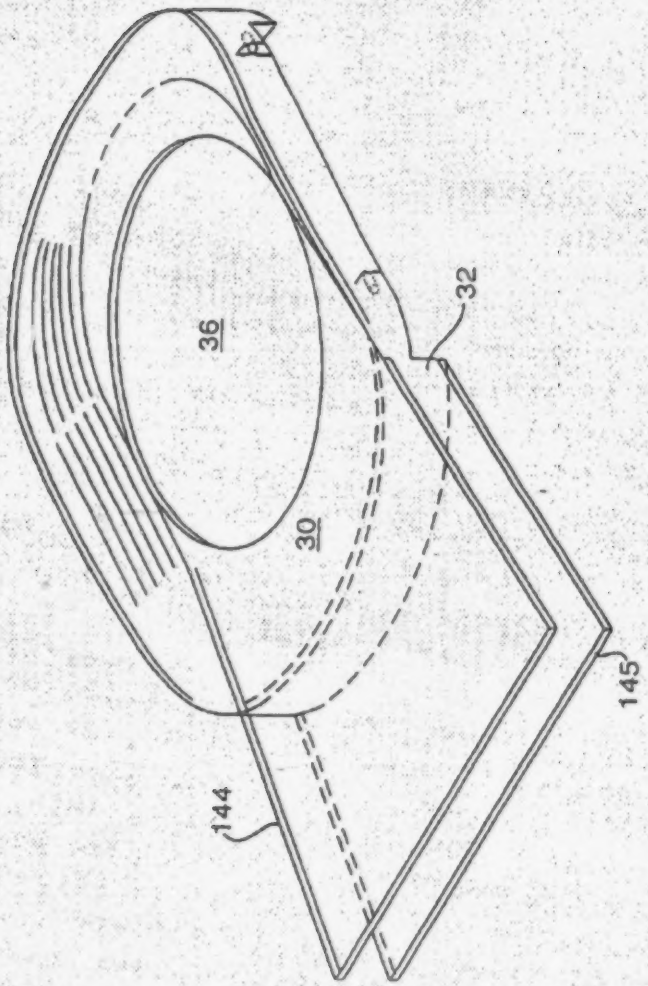


FIG. 6

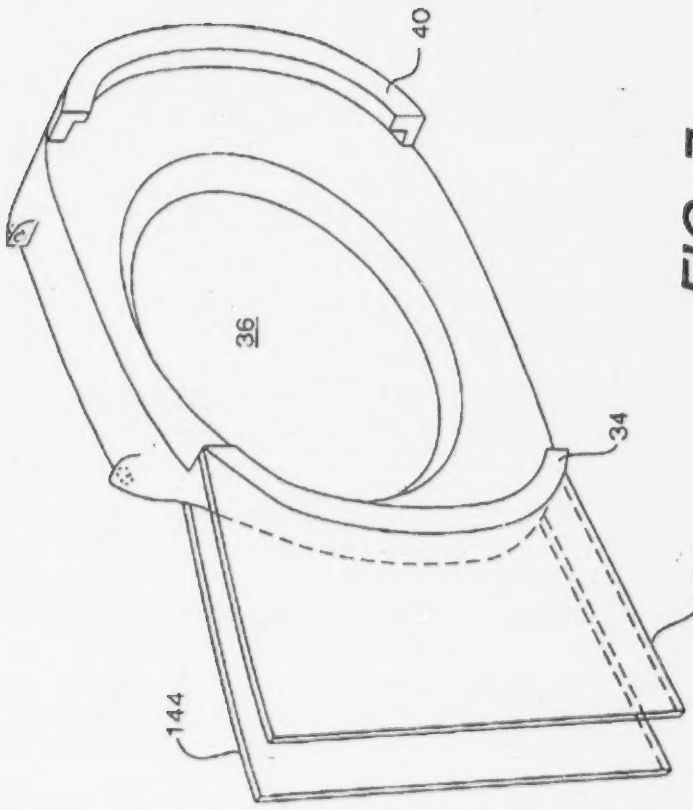


FIG. 7

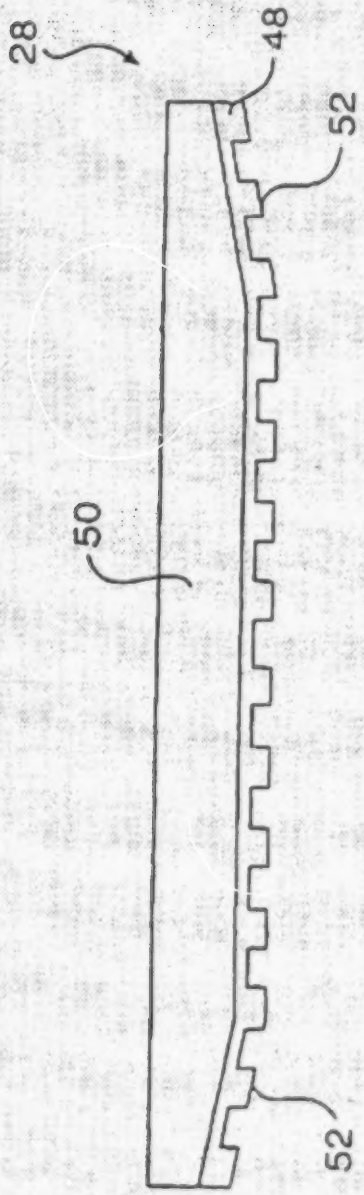


FIG. 8

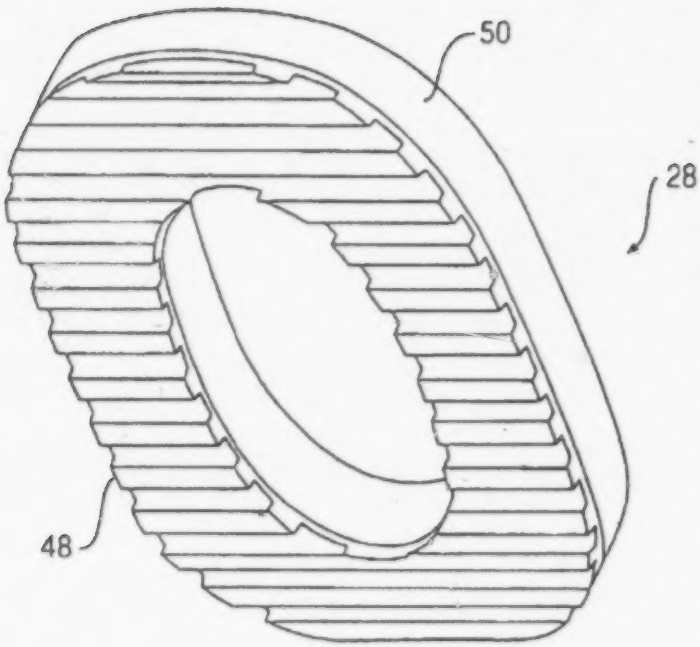


FIG. 9

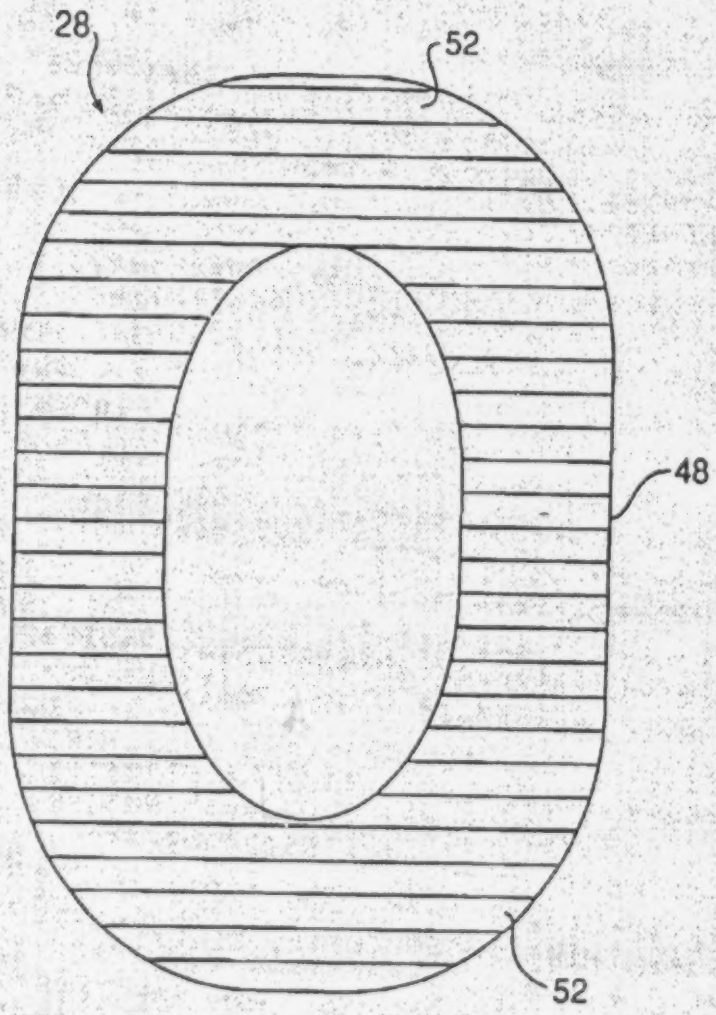


FIG. 10A

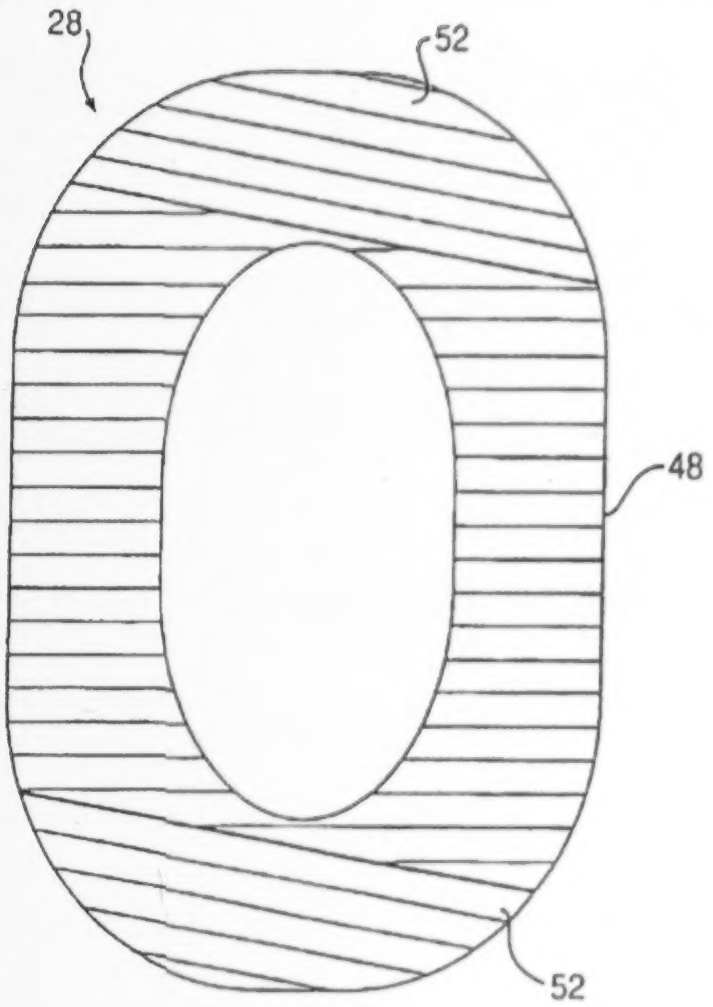


FIG. 10B

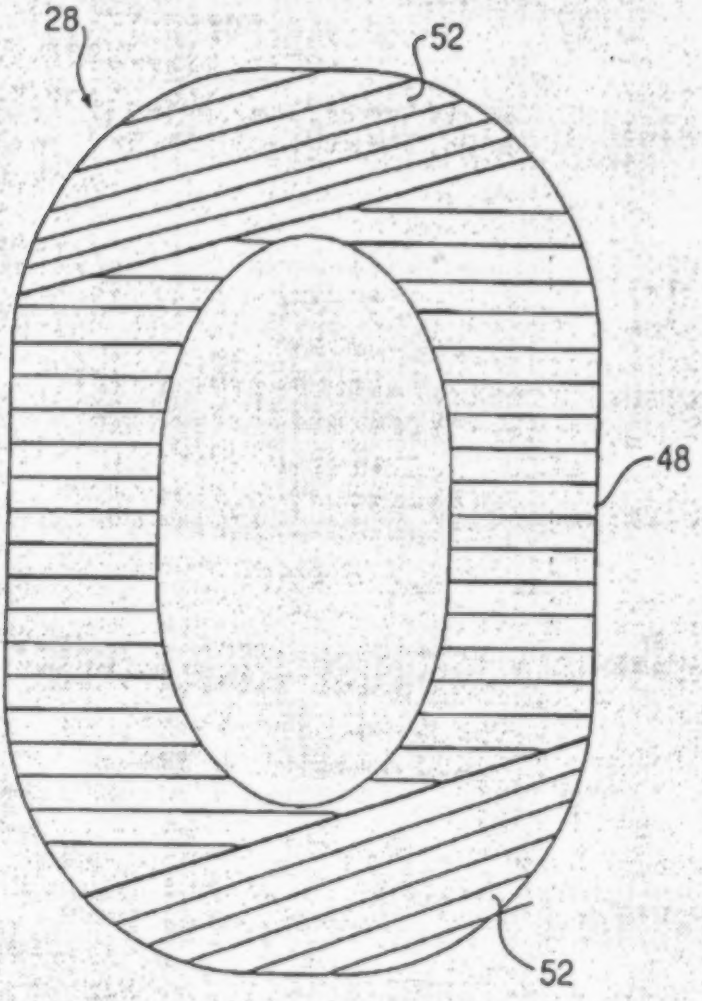


FIG. 10C

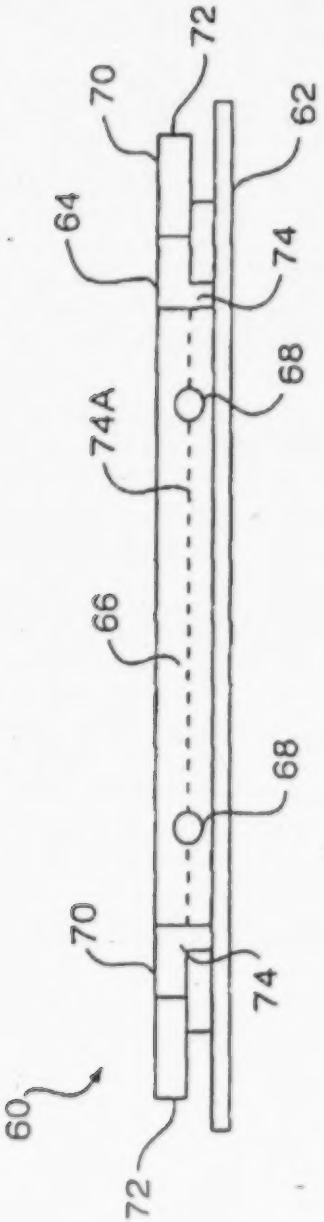


FIG. 11

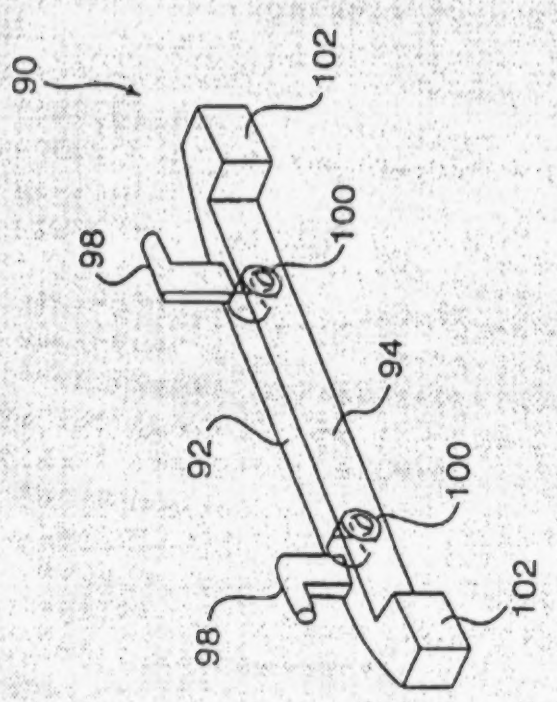


FIG. 12

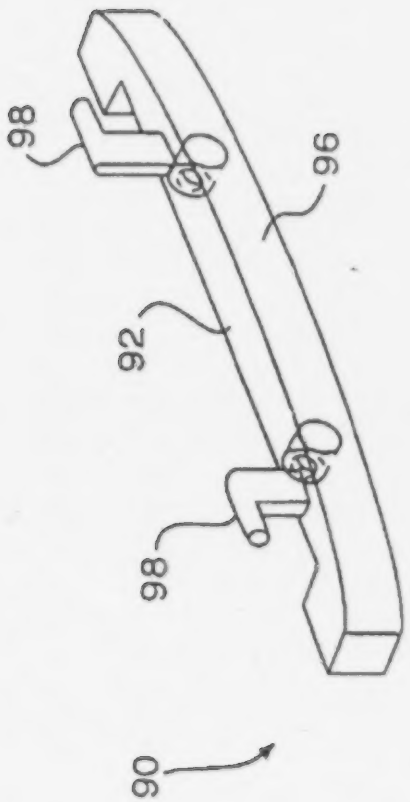


FIG. 13

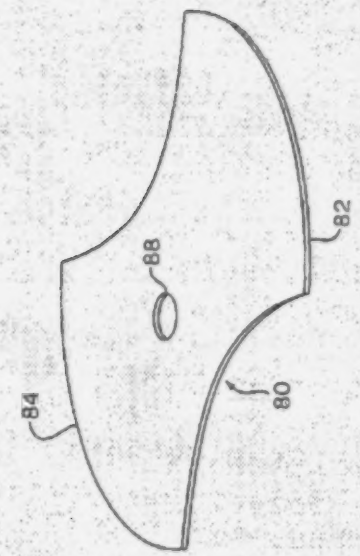


FIG. 14B

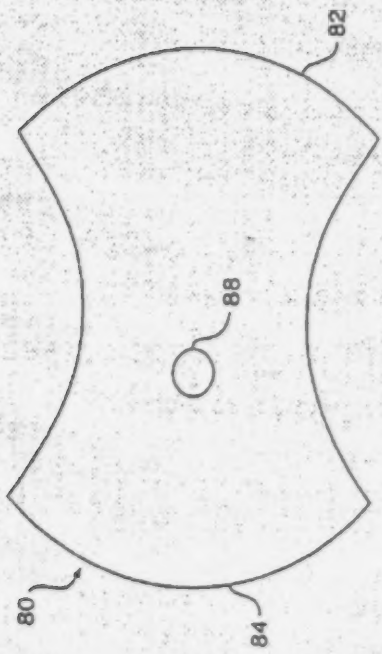


FIG. 14A

FIG. 14C

FIG. 15B

FIG. 15A

FIG. 15C

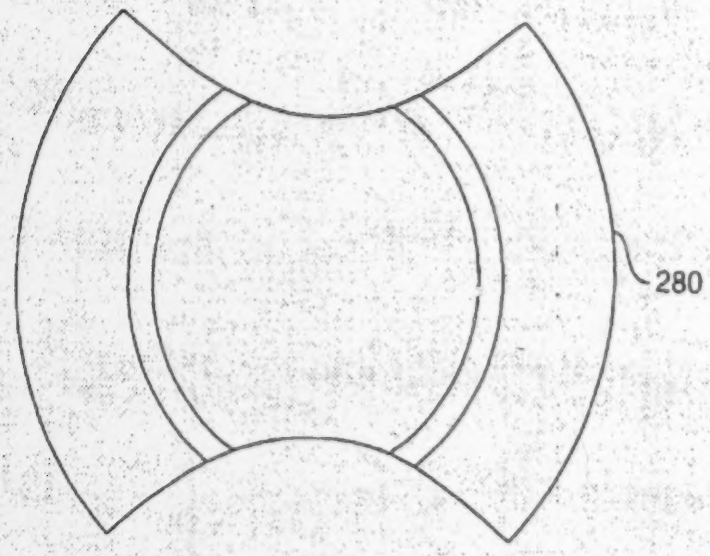


FIG. 16A

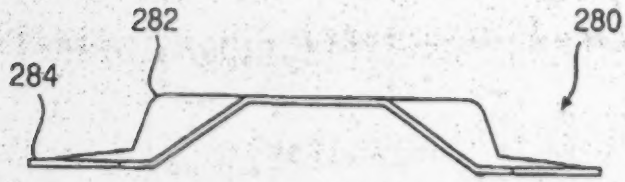


FIG. 16B

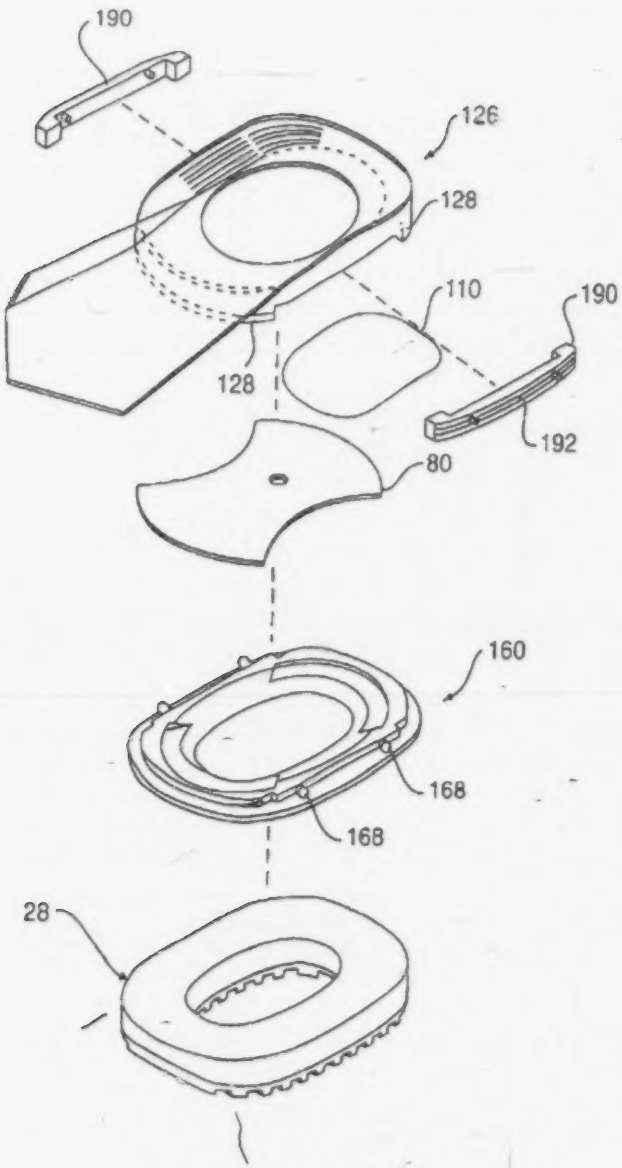


FIG. 17

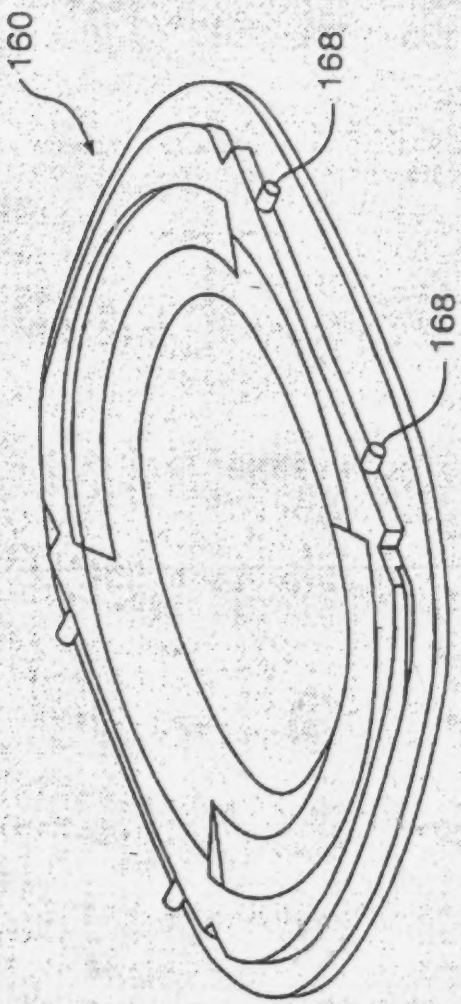


FIG. 18

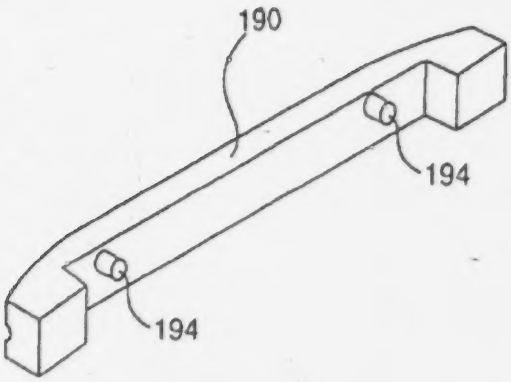


FIG. 19A

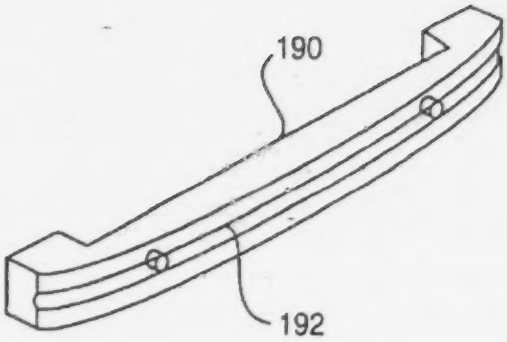


FIG. 19B

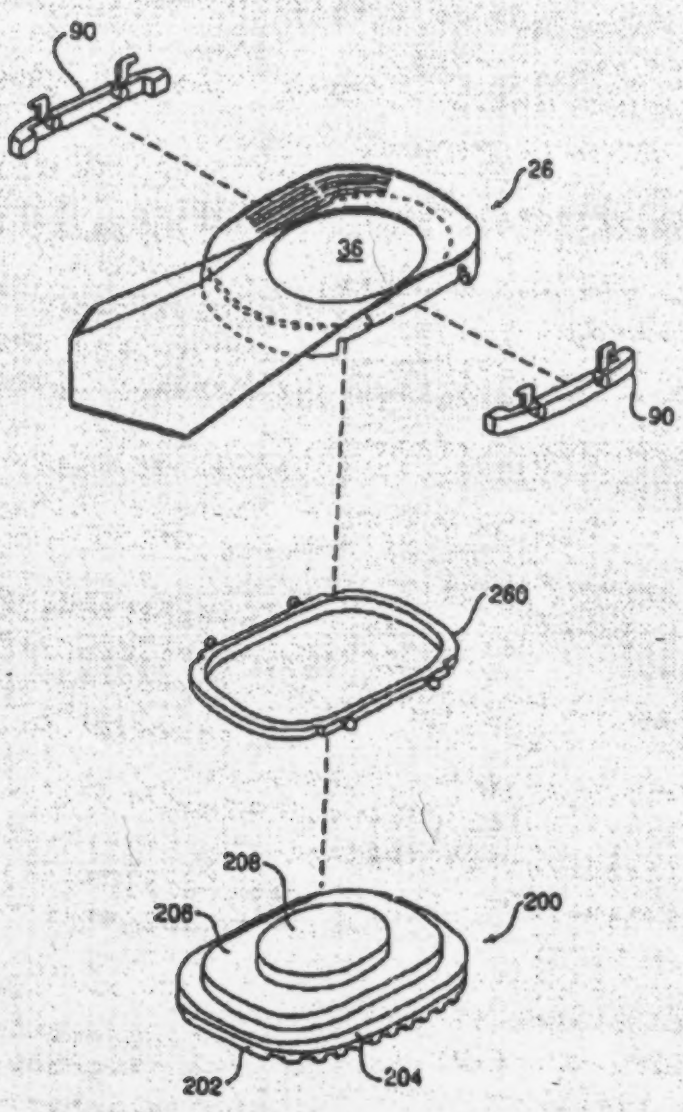
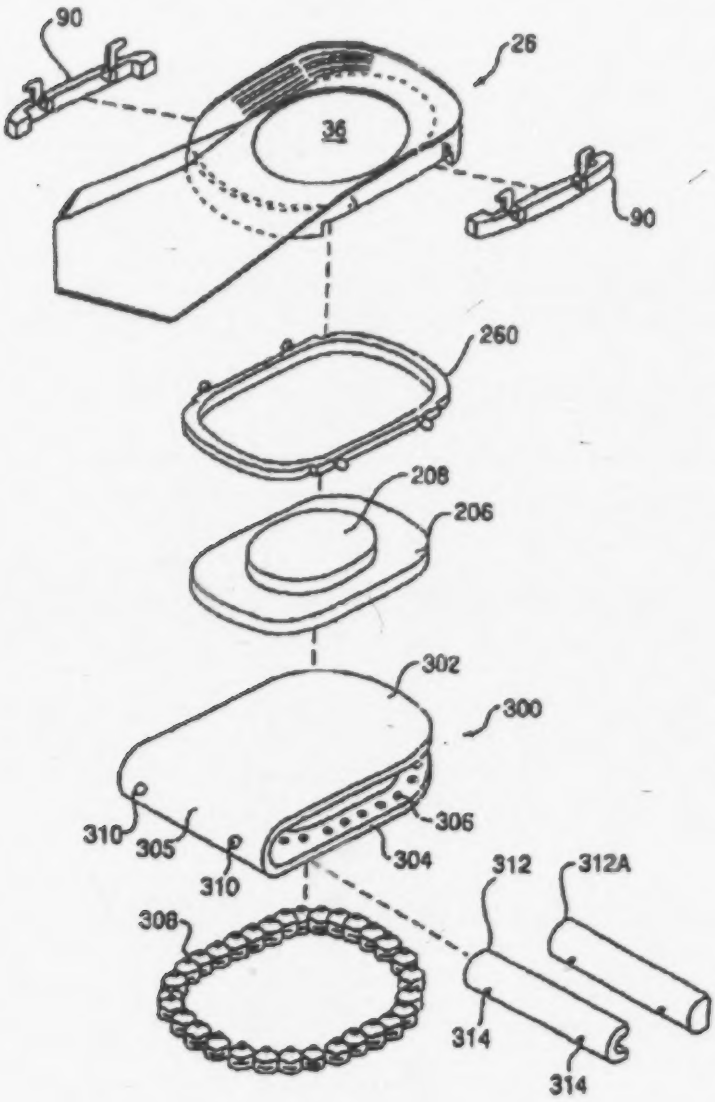


FIG. 20


90
26
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304
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312A
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314
314

FIG. 21

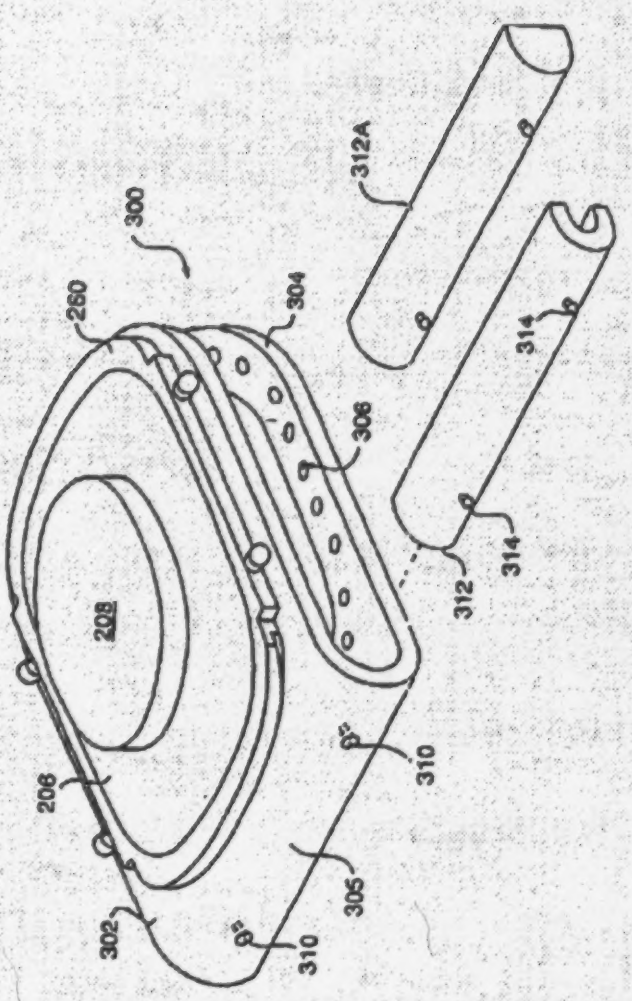

FIG. 22

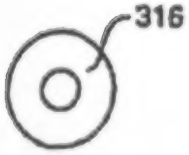

FIG. 23A

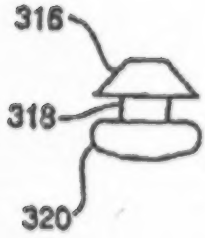

FIG. 23B

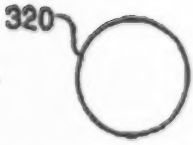

FIG. 23C

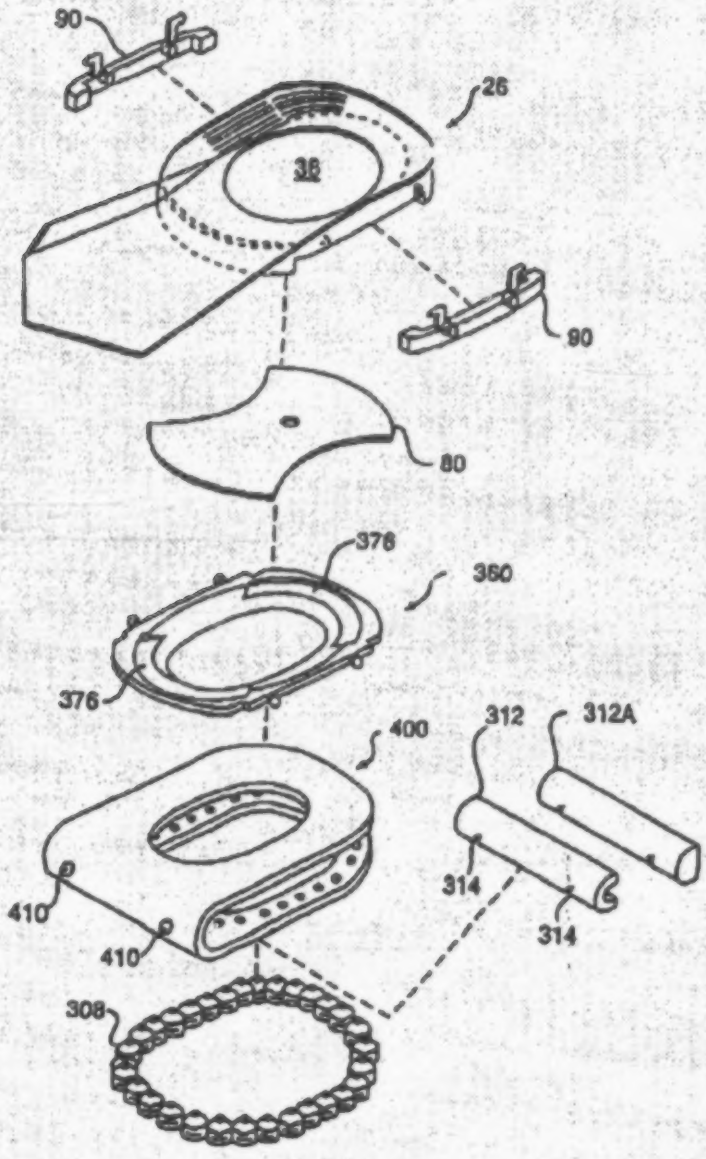

FIG. 24

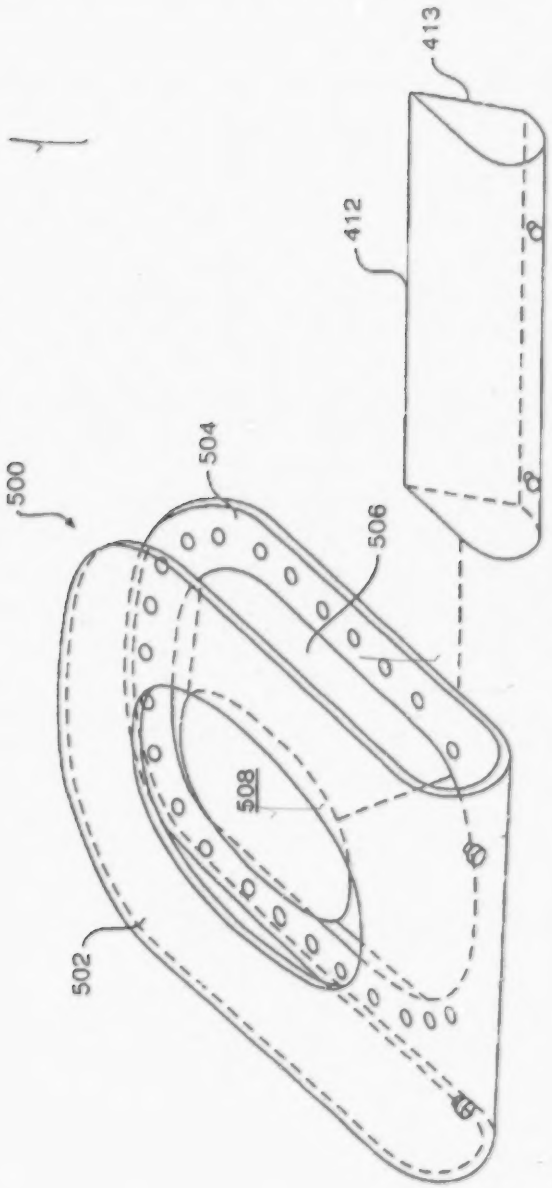

FIG. 25

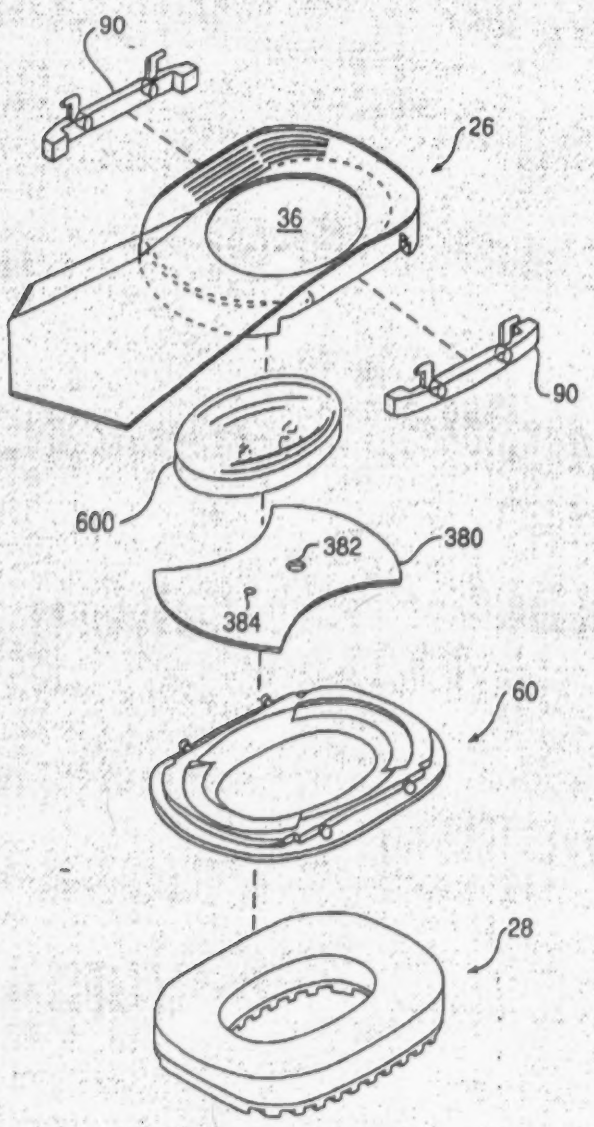

FIG. 26

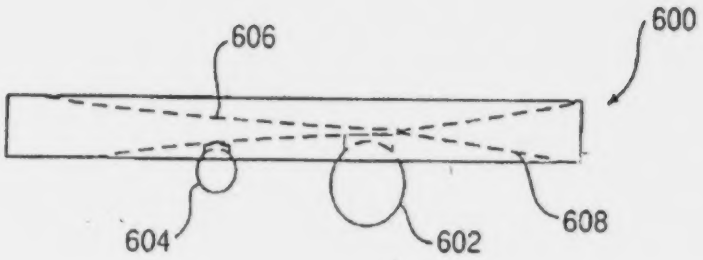

FIG. 27A

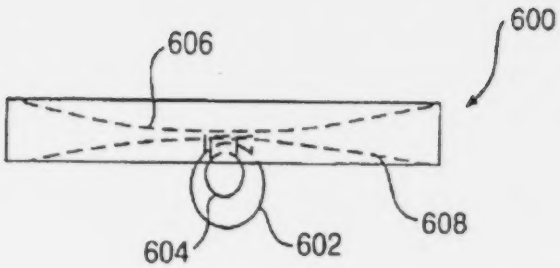

FIG. 27B

ATHLETIC SHOE WITH IMPROVED HEEL STRUCTURE

This is a continuation of application Ser. No. 09/149,142, filed Sep. 8, 1998 now U.S. Pat. No. 5,970,638 which is a continuation of Pat. No. 5,806,210 Ser. No. (08/542,251, filed Oct. 12, 1995) all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to multi-purpose athletic shoes and, more particularly, to athletic shoes with interchangeable/detachable rear soles that provide extended and more versatile life and better performance in terms of cushioning and spring.

2. Discussion of the Related Art

Athletic shoes, such as those designed for running, tennis, basketball, cross-training, biking, walking, and other forms of exercise, typically include a laminated sole attached to a soft and pliable upper. The sole usually includes an abrasion-resistant, rubber outsole attached to a cushioning midsole usually made of polyurethane, ethylene vinyl acetate (EVA), or a rubber compound.

One of the principal problems associated with athletic shoes is wear to both the outsole and midsole. A user rarely has a choice of running or playing surfaces, and asphalt and other abrasive surfaces take a tremendous toll on the outsole. This problem is exacerbated by the fact that, with the exception of the tennis shoe, the most pronounced outsole wear for most users, on running shoes in particular, occurs principally in two places: the outer periphery of the heel and the ball of the foot, with heel wear being, by far, a more acute problem because of the great force placed on the heel during the gait cycle. In fact, the heel typically wears out much faster than the rest of the athletic shoe, thus requiring replacement of the entire shoe even though the bulk of the shoe is still in satisfactory condition.

Midsole wear, on the other hand, results not from abrasive forces, but from repeated compression of the resilient material forming the midsole due to the large force exerted on it during use, thereby causing it to lose its cushioning effect. Midsole compression is also the worst in the heel area, particularly the outer periphery of the heel directly above the outsole wear spot and the area directly under the user's calcaneus or heel bone.

Despite higher prices and increased specialization, no one has yet addressed heel wear problems in an effective way. To date, there is nothing in the art to address the combined problems of midsole compression and outsole wear in athletic shoes, and these problems remain especially severe in the heel area of such shoes.

Designs are known that specify the replacement of the entire outsole of a shoe. Examples include those disclosed in U.S. Pat. Nos. 4,745,693, 4,377,042 and 4,267,650. These concepts are impractical for most applications, however, especially athletic shoes, for several reasons. First, tight adherence between the sole and the shoe is difficult to achieve, particularly around the periphery of the sole. Second, replacement of the entire sole is unnecessary based upon typical wear patterns in athletic shoes. Third, replacing an entire sole is or would be more expensive than replacing simply the worn elements, a factor which is compounded if a replaceable, full-length sole for every men's and women's shoe size is to be produced. Finally, it would appear that the heel section, in particular, has entirely different needs and requirements from the rest of the shoe sole which derive in substantial part from its rate of deterioration.

Other designs, which are principally directed to shoes having a relatively hard heel and outsole (e.g., dress shoes), disclose rear soles that are detachable and which can be rotated when a portion of the rear sole becomes worn. Such designs, however, have never caught on in the marketplace because it is simply too easy and relatively inexpensive to have the entire heel on such footwear replaced at a commercial shoe repair shop.

It is difficult to adapt such "dress shoe" designs to athletic shoes for various reasons. One reason is that the soft, resilient materials utilized in athletic shoe soles make it extremely difficult to devise a mechanism for detachably securing heel elements to each other without adversely affecting the cushioning and other desired properties of the shoe. On the other hand, utilization of hard materials in athletic shoes tends to increase weight and decrease comfort and performance.

For example, U.S. Pat. No. 1,439,758 to Redman discloses a detachable rear sole that is secured to a heel of the shoe with a center screw that penetrates the bottom of the rear sole and which is screwed into the bottom of the heel of the shoe. Such a design cannot be used in athletic shoes because the center screw would detrimentally affect the cushioning properties of the resilient midsole and may possibly be forced into the heel of the user when the midsole is compressed during use. Furthermore, a center screw does little for peripheral adherence of the sole to the shoe heel in the case of resilient materials.

Another truism in the athletic shoe industry is that, while cushioning has received a lot of attention, spring has received very little, despite the fact that materials like graphite and various forms of graphite composite possess the proper characteristics for spring enhancement without increasing weight. One reason may be the perceived tendency of graphite or graphite composite to crack under stress. Yet another reason may be the increased cost associated with such materials. Yet another reason may be that the tremendous variation in body weight and spring preference of would-be users makes it commercially unfeasible to mass-market athletic shoes with graphite spring enhancement, given the countless options that would have to be offered with each shoe size. Since heel spring is largely ignored, it goes without saying that spring options are also non-existent.

Also absent from the marketplace are truly multi-purpose athletic shoes. Notwithstanding a few "run-walk," "aerobic-run," and all-court models, the unmistakable commercial trend appears to be increased specialization, with no apparent industry awareness of the fact that the use and function of an athletic shoe can be changed dramatically if it is simply given interchangeable rear soles. Similarly, no athletic shoe manufacturer has yet to offer varying heel cushioning firmness in each shoe size, despite the fact that consumer body weight for each shoe size spans a huge spectrum. While a few manufacturers offer width options in shoe sizes, varying firmness of cushioning in a single model or shoe size is nonexistent in the marketplace.

SUMMARY OF THE INVENTION

The present invention is directed to a shoe that substantially obviates one or more of the needs or problems due to limitations and disadvantages of the related art.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will

be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the system particularly pointed out in the written description and claims, as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the shoe includes an upper having a heel region and rear sole support attached to the heel region of the upper. The rear sole support includes a base, a first wall extending downwardly from the base and having a first groove, and a second downwardly extending wall opposite the first wall and having a second groove facing the first groove. A rear sole is detachably secured to the rear sole support with a mounting member attached to the rear sole and including at least one rim for engaging the first and second grooves. A locking member engages the rear sole support and one of the rear sole and mounting member to prevent rotation of the rear sole relative to the rear sole support during use. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of one embodiment of a shoe of the present invention.

FIG. **2** is an exploded perspective view of the heel structure for the shoe shown in FIG. **1**.

FIG. **3** is a perspective view of a rear sole support for the heel structure shown in FIG. **2**.

FIG. **4** is a perspective view showing the underside of the rear sole support shown in FIG. **3**.

FIG. **5** is a perspective view of another embodiment of the shoe of the present invention.

FIG. **6** is a perspective view of a rear sole support for the shoe shown in FIG. **5**.

FIG. **7** is a perspective view showing the underside of the rear sole support shown in FIG. **6**.

FIG. **8** is a side view of a rear sole for the heel structure shown in FIG. **2**.

FIG. **9** is a perspective view showing the underside of the rear sole shown in FIG. **8**.

FIGS. **10**A-C are bottom views showing alternative ground-engaging surfaces for the rear sole shown in FIG. **8**.

FIG. **11** is a side view of a mounting member for the heel structure shown in FIG. **2**.

FIG. **12** is a perspective view of a locking member for the heel structure shown in FIG. **2**.

FIG. **13** is a perspective view showing the opposite side of the locking member shown in FIG. **12**.

FIGS. **14**A–C are top, perspective, and side views, respectively, of a flexible plate for the heel structure shown in FIG. **2**.

FIGS. **15**A-C are top, perspective, and side views, respectively, of another embodiment of a flexible plate for use in the heel structure shown in FIG. **2**.

FIGS. **16**A and **16**B are top and side views, respectively, of another embodiment of the flexible plate for use in the heel structure shown in FIG. **2**.

FIG. **17** is an exploded perspective view of another embodiment of the heel structure of the present invention.

FIG. **18** is a perspective view of a mounting member for the heel structure shown in FIG. **17**.

FIGS. **19**A and **19**B are perspective views of a locking member for the heel structure shown in FIG. **17**.

FIG. **20** is an exploded perspective view of another embodiment of the heel structure of the present invention.

FIG. **21** is an exploded perspective view of another embodiment of the heel structure of the present invention.

FIG. **22** is a perspective view of several of the heel components shown in FIG. **21**.

FIGS. **23**A-C are top, side, and bottom views, respectively, of outsole segments for the heel structure shown in FIG. **21**.

FIG. **24** is an exploded perspective view of another embodiment of the heel structure of the present invention.

FIG. **25** is a perspective view of another embodiment of a rear sole for use with the shoe of the present invention.

FIG. **26** is an exploded perspective view of another embodiment of a heel structure of the present invention.

FIGS. **27**A and **27**B are side and front views, respectively, of a wafer for use in the heel structure shown in FIG. **26**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference characters will be used throughout the drawings to refer to the same or like parts.

FIG. **1** illustrates an embodiment of the shoe of the present invention. The shoe, designated generally as **20**, is an athletic shoe principally designed for running, walking, basketball, tennis, and other forms of exercise.

As shown in FIG. **1**, shoe **20** includes an upper **22**, which is that portion of the shoe that covers the upper portion of the user's foot. The upper may be made of leather, a synthetic material, or any combination of materials well known in the art.

A forward sole **24** is attached to the forefoot region of the upper. The forward sole is a lightweight structure that provides cushioning to the forefoot region, and may include an abrasion-resistant rubber outsole laminated to a softer, elastomeric midsole layer. The forward sole is attached to the upper in a conventional manner, typically by injection molding, stitching or gluing.

In some conventional shoes, the forward sole (simply referred to in the industry as a "sole") would extend from the forefoot region to the rear edge of the heel. In other conventional models, portions of the outsole and/or midsole are reduced or eliminated in certain non-stress areas, such as the arch area, to reduce weight. However, in a radical departure from conventional shoes, the shoe of the present invention incorporates a heel structure, including a detachable rear sole, that significantly alleviates heel wear problems associated with conventional soles and provides enhanced cushioning and/or spring.

An embodiment of the heel structure is shown in FIGS. **1** and **2** and includes a rear sole support **26** attached to the heel region of the upper **22**, a rear sole **28** detachably secured to the rear sole support **26**, a mounting member **60** for detachably securing the rear sole **28** to the rear sole support **26**, and locking members **90** for preventing rotation of the rear sole

28 relative to the rear sole support 26 during use. In addition, the heel structure may include a flexible plate 80 for providing spring to the heel of the user and reducing wear caused by midsole compression.

As shown in FIGS. 3 and 4, the rear sole support 26 includes a substantially oval or elliptically-shaped base 30, with somewhat flattened, medial and lateral sides, having a top surface that is attached to the upper by stitching, gluing, or other conventional means. The shape of such base is not limited, and could be circular, polygonal, or any variation of the foregoing. A front wall 32 extends downwardly from a front edge of the base 30, and a rear wall 38 extends downwardly from a rear edge of the base 30. Together, the front and rear walls define a recess that, as later described, receives means for detachably securing the rear sole to the rear sole support.

The front wall 32 includes a lip 34 turned toward the recess, with lip 34 and the recess side of wall 32 defining an arc-shaped front groove. The rear wall 38 includes a lip 40 turned toward the recess, with lip 40 and the recess side of wall 38 defining an arc-shaped rear groove otherwise substantially identical to and facing the front groove. The front and rear grooves have the same radius of curvature and together may constitute arcs of a common circle. At least one, and preferably both, of the front and rear grooves disclosed in FIG. 4 (and all drawings that disclose front and rear grooves), define a circular arc that is less than 180°. As shown in all of such drawings, both of such circular arcs also may substantially traverse the rear sole support 26 from its lateral to its medial side. The front and rear grooves may also be shaped to define arcs of a common circle having a diameter greater than the width of the rear sole support 26 or mounting member 60 or rear sole 28 or even the heel region of the upper 22. The front and rear walls may be flush with the outer edge of base 30 and are spaced from each other on the medial and lateral sides of the base by a distance X, as shown in FIG. 4, which may be slightly greater than the width of the rear sole support 26 or mounting member 60 or rear sole 28.

The rear sole support also has a central opening 36 directly below the heel region of the upper. This central opening, which may be circular, oval, or virtually any polygonal shape, allows the heel of the user to be cushioned by the rear sole attached to the rear sole support or by the flexible plate 80, instead of the firm material comprising the rear sole support.

The rear sole support may be composed of hard plastic, such as a durable plastic manufactured under the name PEBAX™, graphite, a graphite composite, or other material having sufficient rigidity and strength to securely engage the rear sole attaching mechanism (discussed below). Injection molding or other conventional techniques may be used to form the rear sole support.

The rear sole support 26 may also include a heel counter 44, as shown in FIG. 3, for providing lateral stabilization to the user's heel. The heel counter extends upwardly from the edge of the base 30 in a contoured fashion and is preferably made of the same material as, and integral with, the rear sole support through injection molding or other conventional techniques.

As shown in FIGS. 1–4, an arch bridge 46 may generally extend from the base 30 of the rear sole support to the forward sole for supporting the arch region of the foot. The arch bridge 46 is an optional feature composed of a firm, lightweight material. The arch bridge 46 is attached to the upper 22 and forward sole 24 by gluing or other conventional methods. The arch bridge 46 also may be composed of the same material as the rear sole support or a more flexible material and may be made integral with the rear sole support. Such one-piece construction of the arch bridge together with the rear sole support solves a major problem, and that is the tendency of an athletic shoe of conventional "full body" arch construction to curl or twist at the juncture of the hard rear sole support and the resilient forward sole. It also reduces the weight of the shoe by reducing or eliminating the midsole material, e.g., polyurethane or EVA, that would normally occupy the arch area of the shoe.

The rear sole support, heel counter, and arch bridge need not be made of a solid material. Holes or spaces may be created, at the time of manufacture, throughout the structure to decrease weight without diminishing strength.

As an alternative to the arch bridge 46, the rear sole support 26 in all of the embodiments may include upper and lower horizontal walls 144 and 145, as shown in FIGS. 5–7, extending from, and preferably integrated with, front wall 32. In this embodiment, the forward sole 24 extends into the arch region and is sandwiched between upper and lower walls 144 and 145 and against front wall 32. It may then be further secured by gluing. As a further alternative, the rear portion of the forward sole may simply extend to the rear sole support, without upper and lower walls 144 and 145, and be glued to the front wall 32. Alternatively, the rear sole support 26 could have one wall like either 144 or 145 extending from and preferably integrated with it, but not both walls; or posts, rods, or other members, substantially parallel to the ground, could be substituted for walls and may extend from and be integrated with front wall 32 into or along the surface of the midsole or outsole material in the forward sole and then secured by gluing. Other means may be employed as an alternative to the arch bridge 46. An advantage to combining the rear sole support with walls 144 and/or 145, or eliminating both of such walls entirely, and all other alternatives to the integral arch bridge, is that such options, unlike the integral arch bridge, permit manufacture of only one rear sole support suitable for either the left or right shoe, thus decreasing manufacturing costs.

The heel structure shown in FIG. 2 also includes a rear sole 28 detachably secured to the rear sole support. As shown in FIGS. 8 and 9, rear sole 28 may include a ground-engaging outsole 48 laminated to a midsole 50, which may be more resilient than the outsole, with both the outsole and midsole being more resilient than the rear sole support. The outsole, which may be composed of a rubber compound, provides abrasion resistance and some cushioning, while the midsole, which may be composed of a more resilient, elastomeric material such as polyurethane, ethylene vinyl acetate (EVA), HYTREL™ (made by E.I. DuPont de Nemours & Co.), or other materials well known in the art, primarily provides cushioning to the heel during heel strike. Optionally, the rear sole could be comprised of a single homogenous material, or any number of layers or combinations of materials, including a material comprising air encapsulating tubes disclosed, for example, in U.S. Pat. No. 5,005,300.

The outsole 48 may be planar or non-planar. Preferably, the outsole, particularly on running shoe models, includes one or more tapered or beveled segments 52, as shown in FIG. 8, which when located at the rear of the shoe will soften and/or align heel strike during the gait cycle. The beveled segments 52 may be located at the front and rear portions of the rear sole, as shown in FIG. 10A, slightly offset from the front and rear portions, as shown in FIGS. 10B and 10C, or at any other location, depending on the preference of the

user or any heel strike or wear pattern. The beveled segments **52** may also be aligned on a "special order" basis to deal with particular pronation or supination characteristics of the user.

As shown in FIG. **9**, rear sole **28** is elliptical or oval in shape, with somewhat flattened medial and lateral sides, with its length along the major axis of the shoe (when attached to the rear sole support and ready for use) being greater than its lateral width. As a result, the rear sole has a greater ground-engaging surface than if it were circular or equilaterally polygonal. Such increased ground-engaging surface provides greater stability, particularly if multiple or large beveled segments are used. However, the shape of the rear sole **28** may also be circular, polygonal, or otherwise. Rear sole **28** may or may not feature a hole in its center as shown in FIG. **9**, and preferably should not exist if flexible plate **80** (later discussed) is not used.

Rear sole **28** is detachably secured to the rear sole support **26** with a mounting member **60**. As shown in FIGS. **2** and **11**, mounting member **60** has a base layer **62** that is affixed to the top surface of the rear sole **28** with adhesive or other conventional means that will not degrade the cushioning/spring properties of the rear sole. There is an engaging layer **64** above base layer **62** and notch layer **74A**. Lateral sides **66** each contain protrusions **68** with bulbous ends. Front and rear ends **70** of the engaging layer **64** include circular arc-shaped rims **72** having substantially the same radius of curvature as the front and rear grooves of the rear sole support and engage the front and rear grooves of the rear sole support.

To attach the rear sole to the rear sole support, the rear sole, with the mounting member **60** attached (and, optionally, with a flexible plate **80**, discussed later, supported on the mounting member **60**), is positioned relative to the rear sole support so that the front and rear rims of the mounting member are rotated in a circular manner no more than about 90°, about axis Y from their positions shown in FIG. **2**. The mounting member is centered between the front and rear grooves, then pressed against the bottom of the base **30** and rotated less than 180°, and generally no more than about 90° (clockwise or counterclockwise), so that rims **72** fully engage the front and rear grooves of the rear sole support defined by lips **34** and **40** seen in FIG. **4**. When the rear portion of the rear sole becomes worn, the rear sole can be rotated in a circular manner, 180° so that the worn rear portion now faces toward the front of the shoe and occupies an area somewhat forward of the calcaneus where little or no weight of the user is applied. When the rotated rear portion of the rear sole also becomes worn, the rear sole may be detached and exchanged with the rear sole of the shoe, since wear patterns of left and right heels are typically opposite. The rear sole may also be discarded and replaced with a new one with or without any rotation or exchange between left and right shoe.

The mounting member **60** may be made of any number of hard, lightweight materials that provide sufficient strength and rigidity to firmly engage the rear sole support, and support the flexible plate **80** if used. Examples of such materials include: hard plastic, PEBAX™; HYTREL™ in its hard format, graphite, and graphite, graphite/fiberglass, and fiberglass composites. Hardness of the mounting member may in fact be especially important if flexible plate **80** is used, because the peripheral edges of such plate need to press against a firm foundation of the central portion of such plate is to properly deflect under the weight of the user's foot and impart spring to the user's gait cycle. In any event, the mounting plate material is generally stiffer than the materials used for the rear sole midsole and outsole.

Base layer **62** may be entirely eliminated from the mounting member **60** shown in FIG. **2**, in which case the periphery of the top surface of rear sole **28** presses tightly against lips **34** and **40** of the rear sole support when engaged.

To prevent the rear sole from rotating relative to the rear sole support once engaged with each other, locking members **90** lock the mounting member to the rear sole support at the appropriate orientation. As shown in FIGS. **12** and **13**, locking member **90** includes a base **92** with a substantially planar inner surface **94** and an outer surface **96** contoured according to the sides of the rear sole support when attached thereto. A pair of L-shaped arms **98** extend from the base **92** (preferably from its top, e.g., from the external surface of the heel counter) and engage opposed openings **42** (FIG. **2**) in the rear sole support to pivotally attach the locking member **90** to the rear sole support. Openings **42** may also be formed in the heel region of the upper. When attached to the rear sole support, the locking members occupy the spaces (having a length X as shown in FIG. **4**) between the front and rear walls of the rear sole support, as shown in FIG. **1**.

Apertures **100** are formed in the base **92** for receiving the protrusions **68** of mounting member **60**. The apertures have a small opening adjacent surface **94**, then expand in diameter within the base to a larger opening near surface **96** to accommodate the bulbous ends of the protrusions **68**. As a result, the protrusions "snap" into the apertures **100** to lock the locking members in position. In addition, projections **102** extend inwardly from opposite ends of base **92** and engage notches **74** in the mounting member between the front and rear ends and the lateral sides (FIGS. **2** and **11**) to prevent rotation of the rear sole when the locking members are in the position shown in FIG. **1**.

As shown in FIG. **2**, mounting member **60** includes slots **76** for supporting a flexible plate **80** between the rear sole and the heel portion of the upper so that a portion of plate **80** is exposed through central opening **36**. The flexible plate, which may be made of a graphite composite or other stiff, but flexible, material, reduces heel-center midsole compression and provides spring to the user. The flexible plate is, of course, stiffer than the materials used for the outsole or midsole, but must be sufficiently flexible so as to not detrimentally affect cushioning of the user's heel. A graphite or graphite/fiberglass composite, including carbon or carbon and graphite fibers woven in an acrylic or resin base, such as those manufactured by Biomechanical Composites Co. of Camarillo, Calif., may be used.

As shown in FIGS. **14A-C**, flexible plate **80** includes front and rear edges **82** and **84** that are supported by slots **76** (see FIG. **2**) in the mounting member. The flexible plate may have a substantially convex upper surface that curves upwardly between the front and rear edges to an apex **86**, which is preferably located below the calcaneus of the user when the rear sole is attached to the rear sole support. An aperture **88** may be provided at the apex **86** to increase spring.

The plate may also be flat or concave, and may be substantially hour glass-shaped, as shown in FIGS. **14A-C**, or H-shaped, as is the plate **180** shown in FIGS. **15A-C**. Other shapes are also contemplated as long as such shapes provide spring and reduce midsole compression of the rear sole. For example, FIGS. **16A** and **B** show another hour glass-shaped flexible plate **280** with discrete upper and lower sections **282** and **284**.

When the flexible plate is used, the rear sole may be devoid of material in its center, as shown in FIG. **2**, to reduce the weight of the rear sole. If the center is devoid of material,

a thin horizontal membrane (not shown), with or without a flanged edge, composed of plastic or other suitable material may be inserted into the void and attached to the walls of the void, by compression fit or otherwise, to seal the void and prevent moisture or debris from entering or collecting therein.

Apex **86** is located, in FIGS. 14C and 15C, slightly to the rear of the center of the major axis of plate **80**, so as to be positioned more directly beneath the center of the calcaneus. Thus, it will be necessary to remove and rotate plate **80** by 180 on an axis perpendicular to the major axis of the shoe when the rear sole is rotated, in order to keep the apex positioned directly beneath the calcaneus. However, plate **80** may be formed with the apex in any position to suit a user's preference. It may even be placed in the exact center of plate **80** so as to obviate the need for plate rotation when the rear sole is rotated.

Flexible plate **80** provides spring to the user's gait cycle in the following manner. During heel strike in the gait cycle, the user's heel provides a downward force against the plate. Since the peripheral edges of the plate are firmly supported by the mounting member, the interior portion of the plate deflects downwardly relative to the peripheral edges. As the force is lessened (with the user's weight being transferred to the other foot) the deflected portion of the plate, due to its elastic characteristics, will return to its original shape, thereby providing an upward spring force to the user's heel. Such spring effect will also occur whenever a force is otherwise applied to and then removed from the flexible plate (e.g., jumping off one foot, or jumping from both feet simultaneously).

The removability of the flexible plate allows the use of several different types of flexible plates of varying stiffness or composition. Thus, flexible plate designs and characteristics can be adapted according to the weight of the user, the ability of the user, the type of exercise or use involved, or the amount of spring desired in the heel of the shoe. Removability also permits easy replacement of the plate should deterioration occur, a concern in the case of virtually any truly spring-enhancing plate material.

The heel structure embodiment shown in FIG. 2 is but one of many embodiments contemplated by the present invention. While further embodiments are discussed below, additional embodiments are possible and within the scope of the invention. Unless otherwise noted, the structure, material composition, and characteristics of the heel components shown in FIGS. 1 and 2 apply to all of the embodiments.

One such embodiment is shown in FIGS. 17–19B. In this embodiment, rear sole support **126** is substantially identical to rear sole support **26** shown in FIG. 2 except that it has horizontal grooves **128** on the exterior surfaces of each of the downwardly extending walls and no holes **42**. The mounting member **160** shown in FIG. 17 is also identical to mounting member **60** shown in FIG. 2 except that protrusions **168** do not have bulbous ends.

Locking members **190** differ from those shown in FIG. 2 in that the hinges are eliminated. Instead, the exterior surfaces of each of the locking members **190** have a horizontal groove **192** that aligns with the exterior grooves **128** formed on the rear sole support. In addition, apertures **194** (FIG. 19A) are cylindrical in shape and need not have expanded interior portions since the protrusions **168** have no bulbous ends.

To lock the locking members in place, an elastic band **110** is stretched and fitted within the grooves **128** on the rear sole support and grooves **192** on the locking members. The elastic band **110** may be a separate component completely removable from the rear sole support, as shown in FIG. 17, or permanently secured to the rear sole support by, for example, enclosing one of the grooves **128** after the elastic band has been inserted therein. Also, the band may be pushed or rolled upward above grooves **128** on the rear sole support prior to detaching locking members **190**, and then simply rolled downward to return to an in-groove position following reattachment. As a further option, the elastic band may be a removable or permanently attached strap fitted within the grooves and having opposing ends that may be latched together like a belt or ski boot latch.

As a further alternative (not shown), a U-shaped connector having opposite ends permanently attached to one end of both locking members **90** may be removably or permanently secured to the outer surface of either the front or rear wall of the rear sole support, as a substitute for the system involving hinges **98** on locking members **90**. The elastic band and other alternatives to the hinged locking member can be used in all of the embodiments of the invention.

If a flexible plate is not desired, the embodiment shown in FIG. **20** may be used to supply more conventional midsole cushioning. In this embodiment, the mounting member **260** is identical to the mounting member **60** shown in FIG. 2 except that the base layer **62** and slots **76** are eliminated. It should again be noted that the base layer **62** is an optional feature in all of the mounting member embodiments. In place of the rear sole **28** shown in FIG. 2, a rear sole **200** has an abrasion-resistant outsole **202** laminated to a midsole layer **204**. On top of this midsole layer **204** are two additional midsole layers **206** and **208**, each layer being smaller than the layer upon which it rests, with midsole layer **208** sized to fit within the central opening **36** in the rear sole support **26**. Midsole layers **206** and **208** may comprise two separate pieces laminated together or a single piece molded or otherwise shaped to have two regions as shown.

In this embodiment, the mounting member **260** is adhered by gluing or other means to the top of the midsole layer **204** such that it surrounds and abuts against the sides of midsole layer **206**. It may be further secured to the sides of midsole layer **206** by gluing or other means. The manner of attaching the rear sole and mounting member to the rear sole support is identical to that described with respect to the embodiment shown in FIG. 2. In addition, the top midsole layer **208** may, but need not be, made circular to facilitate rotation of the rear sole when the midsole layer **208** is pressed into the central opening **36**. Alternatively, this layer may be severed from layer **206** and placed in opening **36** with the shoe in an inverted position. This may make installation easier if layer **208** is oval in shape, like opening **36**. It also permits replacement of layer **208**, should its cushioning properties deteriorate at a faster rate than the rest of the rear sole. Of course, this step would be accomplished before engagement of mounting member **260** with rear sole support **26**, which similarly could be accomplished while the shoe is in an inverted position in order that layer **208** does not fall out or dislodge during installation.

It should be noted that layers **204**, **206**, and **208** may be made of different cushioning materials, including without limitation air-filled chambers, gell-filled chambers, EVA or polyurethane, or any combinations thereof.

The rear sole support is designed to accommodate a variety of rear sole configurations, which vary according to the activity involved, the weight of the user, and the cushioning and/or spring desired by the user. Although additional rear sole configurations are discussed below, many other rear

sole configurations may be used in conjunction with the rear sole support **26**.

One such example is shown in FIGS. **21** and **22**. In this embodiment, a rear sole **300** is a U-shaped member having substantially parallel walls **302** and **304** joined by a bend **305**. The member is composed of a stiff, but flexible, material that will provide spring to the heel of the user without sacrificing comfort. Materials such as those disclosed with respect to the flexible plate **80** may be used for the rear sole **300**.

Two layers of resilient midsole material **206** and **208**, which may be more resilient than the U-shaped member, are secured to the top of wall **302** by gluing or other means to provide cushioning to the heel of the user, and mounting member **260** is glued or otherwise attached to the top surface of top wall **302** to surround and abut against the sidewall of midsole layer **206**. It may also be attached to the side wall of layer **206** by gluing or other means. The mounting member may also be molded to the rear sole **300** as a one-piece structure. The midsole layers **206** and **208**, the mounting member **260**, and the rear sole support **26** (as well as optional features) are identical to those shown in FIG. **20**, and the manner and options for attaching the rear sole and mounting member to the rear sole support is the same, including without limitation the option of severing and separately installing layer **208**.

To protect the bottom ground-engaging surface of the U-shaped member and to provide cushioning, the rear sole may include an abrasion-resistant outsole which may be more resilient than the U-shaped member. As shown in FIG. **21**, the bottom wall **304** of the rear sole **300** includes holes **306** through which removable outsole segments **308** are inserted. The outsole segments **308**, which may be made of a rubber compound or other material typically used for outsole material, provide an abrasion-resistant layer for protecting the bottom surface of wall **304**. As shown in FIGS. **23A–C**, the outsole segments have a substantially conically-shaped top portion **316**, a cylindrical middle portion **318**, and a rounded ground-engaging portion **320**. The conically-shaped portion **316** snaps into openings **306**, and the bottom of the conically-shaped portion acts to retain the outsole segments in the openings. Alternatively, a one-piece outsole layer may be attached to the bottom surface of wall **304**, utilizing openings **306** and segments **308**, or eliminating both and utilizing gluing or some other means instead. Such outsole layer may then be permanent or removable.

The rear sole **300** provides spring to the heel of the user in the following manner. When the heel of the user strikes the ground, wall **304** will deflect toward wall **302**. Since the material is elastic, energy stored in bend **305** and wall **304** during deflection will spring bend **305** and wall **304** back to their original position as weight is shifted, thereby providing a spring effect to the user's heel. Stiffening members **312** or **312A** are optional elements that may be used to increase the spring generated by the rear sole **300**. The stiffening members include protrusions **314** that engage apertures **310** in the bend of the rear sole **300**. Alternatively, bottom wall **304** (shown with large hole in middle) may be solid to increase spring or may be tent-shaped as shown in FIG. **25** to further increase spring, with or without a stiffening member **412**.

Flexible plate **80** may also be used in conjunction with a rear sole very similar to that shown in FIG. **21**. As shown in FIG. **24**, rear sole **400** is identical to rear sole **300** shown in FIG. **21** except that it has an optional opening in the top wall to reduce the weight of the rear sole and allow additional space within which flexible plate **80** may flex. Alternatively, the bottom wall may be solid to increase spring or may be tent-shaped as shown in FIG. **25** to further increase spring, with or without a stiffening member **412**. Mounting member **360** is similar to that shown in FIG. **2** except that the base **62** is deleted. Again, flexible plate **80** rests in slots **376** formed in the moulding member and is exposed to the heel region of the upper via the central opening **36** in the rear sole support **26**.

Another rear sole option is shown in FIG. **25**. In this embodiment, rear sole **500** is identical to rear sole **400** shown in FIG. **24** except that it has a "tent-like" wall **506** extending from the bottom wall **504** toward top wall **502**. Wall **506** may have a top surface **588**, or may be devoid of material at this location. Wall **506** has the effect of increasing stiffness and, therefore, provides more spring than that of the rear sole **400** as shown. A stiffening member **412** may also be used to further increase spring. Stiffening member **412** is identical to member **312** shown in FIG. **24** except that it has a slanted wall **413** to complement and press against the front sloped surface of wall **506**. Top wall **502** may have a central opening, as shown in FIG. **25**, or may be solid, such as wall **302** shown in FIG. **21**. Wall **506** may be used in any of the U-shaped rear sole embodiments.

Finally, an optional wafer **600**, usable in combination with any of the above embodiments incorporating a flexible plate, is disclosed in FIGS. **26–27B**. As shown in FIG. **26**, wafer **600** is disclosed in conjunction with the heel structure shown in FIG. **2**. Wafer **600** is placed on the top surface of flexible plate that it is exposed to the heel region of the upper (not shown) via central opening **36** of rear sole support **26**. Wafer **600** is made of any suitable materials, such as those materials disclosed for the midsole layer or outsole layer of rear sole **28**, that provide cushioning to the heel of the user and which are more resilient than the flexible plate.

As shown in FIGS. **27A** and **27B**, wafer **600** includes knobs **602** and **604** that snap engage with corresponding openings **382** and **384** (see FIG. **26**) in flexible plate **380**. Although two knobs are shown in this embodiment, any number of knobs may be used; in fact, the knobs may be eliminated entirely.

As shown in FIG. **26**, wafer **600** is oval in shape, although any shape is contemplated so long as it provides the desired cushioning to the heel of the user. If desired, the bottom surface **608** of wafer **600** may be concave in order to conform with the curved top surface of flexible plate **380**. The top surface **606** of wafer **600** may also be concave in order to conform with the contours of the heel region of the upper or the user's heel.

The wafer need not be attached to the flexible plate **380**. Instead, the wafer may, for example, be permanently attached to the bottom of the upper, secured within or made integral with a shoe sock liner (not shown), secured to the rear sole support, or attached at any other location that would be capable of cushioning the user's heel.

It will be apparent to those skilled in the art that various modifications and variations can be made in the shoe of the present invention without departing from the scope or spirit of the invention and that certain features of one embodiment may be used interchangeably in other embodiments. By way of example only, the rear sole support/locking member combinations shown in FIGS. **2** and **17** can be used in conjunction with any of the above-described rear sole configurations, and can be used with or without the flexible plate. Similarly, the arch bridge shown in FIGS. **1–4**, upper and lower horizontal walls shown in FIGS. **5–7** and other alternatives to the arch bridge discussed herein may be

employed with any embodiment shown. Thus, it is intended that the present invention cover all possible combinations of the features shown in the different embodiments, as well as modifications and variations of this invention, provided they come within the scope of the claims and their equivalents.

What is claimed is:

1. A shoe comprising:

an upper, and

a rear sole secured below a portion of the upper, the rear sole comprising:

a member having a top wall with a lower surface, the top wall having at least one peripheral edge proximate a medial side of the shoe and at least one peripheral edge proximate a lateral side of the shoe, the peripheral edges of the top wall having a mid-longitudinal axis therebetween, the top wall having an opening beneath the wearer's heel, the mid-longitudinal axis of the peripheral edges of the top wall including a point that is vertically aligned with the approximate center of the opening in the top wall and the approximate center of the wearer's heel, the member having a bottom wall with an upper surface, the bottom wall having at least two portions approximately planar with each other, parallel with the ground, and separated by a gap therebetween, the top wall and the bottom wall each having a forward region and a rearward region, the forward regions of the top and bottom walls being connected at a closed end by a curved wall; the top, bottom, and curved walls being integral, the rearward regions of the top and bottom walls being oriented toward a back of the shoe, at least a portion of the top and bottom walls being spaced a predetermined distance from each other such that during the wearers gait cycle when the shoe is in contact with the ground the predetermined distance between the at least a portion of the top and bottom walls is reduced;

at least one element positioned between at least a portion of the top wall and at least a portion of the bottom wall, the at least one element having at least one interior sidewall;

a void located beneath the opening in the top wall defined at least in part by the at least one interior sidewall of the at least one element, at least a portion of the void being vertically aligned with the approximate center of the opening in ...p top wall;

at least one opening on at least one of the medial and lateral sides of the shoe, the opening being in communication with the void; and

a bottom surface that is at least in part ground-engaging.

2. The shoe of claim 1, wherein a cross-sectional profile of the top and bottom walls that are connected at the closed end by the curved wall is generally in a recumbent U-shape.

3. The shoe of claim 1, wherein the reduced predetermined distance between the at least a portion of the top and bottom walls results from the at least a portion of one of the top and bottom walls deflecting toward the other in a substantially vertical direction.

4. The shoe of claim 1, wherein the reduced predetermined distance between the at least a portion of the top and bottom walls results from the at least a portion of the top wall deflecting toward the ground in a substantially vertical direction.

5. The shoe of claim 1, wherein the top wall has at least one peripheral edge proximate the rear of the shoe.

6. The shoe of claim 5, wherein the at least one peripheral edge of the top wall proximate one of the medial side of the shoe, the lateral side of the shoe, and the rear of the shoe is visible from outside the shoes.

7. The shoe of claim 1, wherein the bottom wall has at least one peripheral edge proximate one of the medial side of the shoe and the lateral side of the shoe.

8. The shoe of claim 7, wherein the at least one peripheral edge of the bottom wall is at least in part visible from outside the shoe.

9. The shoe of claim 1, wherein one of the at least two portions of the bottom wall has at least one peripheral edge proximate the medial side of the shoe and another of the at least two portions of the bottom wall has at least one peripheral edge proximate the lateral side of the shoe, the peripheral edges being approximately parallel with each other.

10. The shoe of claim 9, wherein the peripheral edges of the at least two portions of the bottom wall proximate the medial side and lateral side of the shoe are at least in part visible from outside the shoe.

11. The shoe of claim 9, wherein each of the at least two portions of the bottom wall has an interior edge, the interior edges of the at least two portions of the bottom wall being substantially planar with each other and substantially parallel with the ground.

12. The shoe of claim 1, wherein the curved wall has at least one peripheral edge proximate one of the medial side of the shoe and the lateral side of the shoe.

13. The shoe of claim 12, wherein the at least one peripheral edge of the curved wall is at least in part visible from outside the shoe.

14. The shoe of claim 1, wherein the curved wall has a mid-longitudinal axis, with an opening along the mid-longitudinal axis of the curved wall.

15. The shoe of claim 1, wherein the curved wall is approximately perpendicular to the major longitudinal axis of the shoe.

16. The shoe of claim 1, further comprising a cushion positioned beneath the wearer's heel and above at least a portion of the top wall of the member, the cushion and the top wall each being made of a material, the material of the cushion being more resilient than the material of the top wall.

17. The shoe of claim 16, wherein the cushion has an upper surface conforming in shape to the bottom surface of the wearer's heel.

18. The shoe of claim 17, wherein the cushion is located at least in part beneath the approximate center of the wearer's heel.

19. The shoe of claim 18, wherein the cushion is located beneath and adjacent at least a portion of the upper.

20. The shoe of claim 1, wherein the opening in the top wall is visible at least in part through the at least one opening on at least one of the medial and lateral sides of the shoe.

21. The shoe of claim 1, wherein the lower surface of the top wall is at least in part visible from outside the shoe through the at least one opening on one of the medial and lateral sides of the shoe.

22. The shoe of claim 1, wherein the upper surface of the bottom wall is at least in part visible from outside the shoe through the at least one opening on at least one of the medial and lateral sides of the shoe.

23. The shoe of claim 1, wherein the interior sidewall of the at least one element is at least in part visible from outside the shoe through the at least one opening in one of the medial and lateral sides of the shoe.

24. The shoe of claim 1, wherein the at least one interior sidewall of the at least one element is at least in part visible from outside the shoe.

25. The shoe of claim 1, wherein an entire portion of the top wall over the at least one element is solid.

26. The shoe of claim 1, wherein the bottom surface of the rear sole has a non-ground-engaging portion that is vertically aligned with at least a portion of the opening in the top wall.

27. The shoe of claim 26, wherein the non-ground-engaging portion of the bottom surface of the rear sole is located at least in part between the at least two portions of the bottom wall.

28. The shoe of claim 26, wherein the non-ground-engaging portion of the bottom surface of the rear sole comprises a substantially planar portion and an adjacent portion non-planar with the planar portion.

29. The shoe of claim 26, wherein the non-ground-engaging portion of the bottom surface of the rear sole comprises a tent-shaped portion extending toward the top wall.

30. The shoe of claim 29, wherein the tent-shaped portion extending toward the top wall has at least one sidewall at an angle to the at least in part ground-engaging portion of the bottom surface, the at least one interior sidewall of the at least one element being at an angle to the at least in part ground-engaging portion of the bottom surface, the at least one sidewall of the tent-shaped portion being adjacent the at least one interior sidewall of the at least one element.

31. The shoe of claim 30, wherein the angle of the at least one sidewall of the tent-shaped portion that is adjacent the at least one interior sidewall of the at least one element is approximately the same as the angle of the at least one interior sidewall of the at least one element that is adjacent the at least one sidewall of the tent-shaped portion.

32. The shoe of claim 1, wherein the at least in part ground-engaging portion of the bottom surface is formed of outsole material.

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